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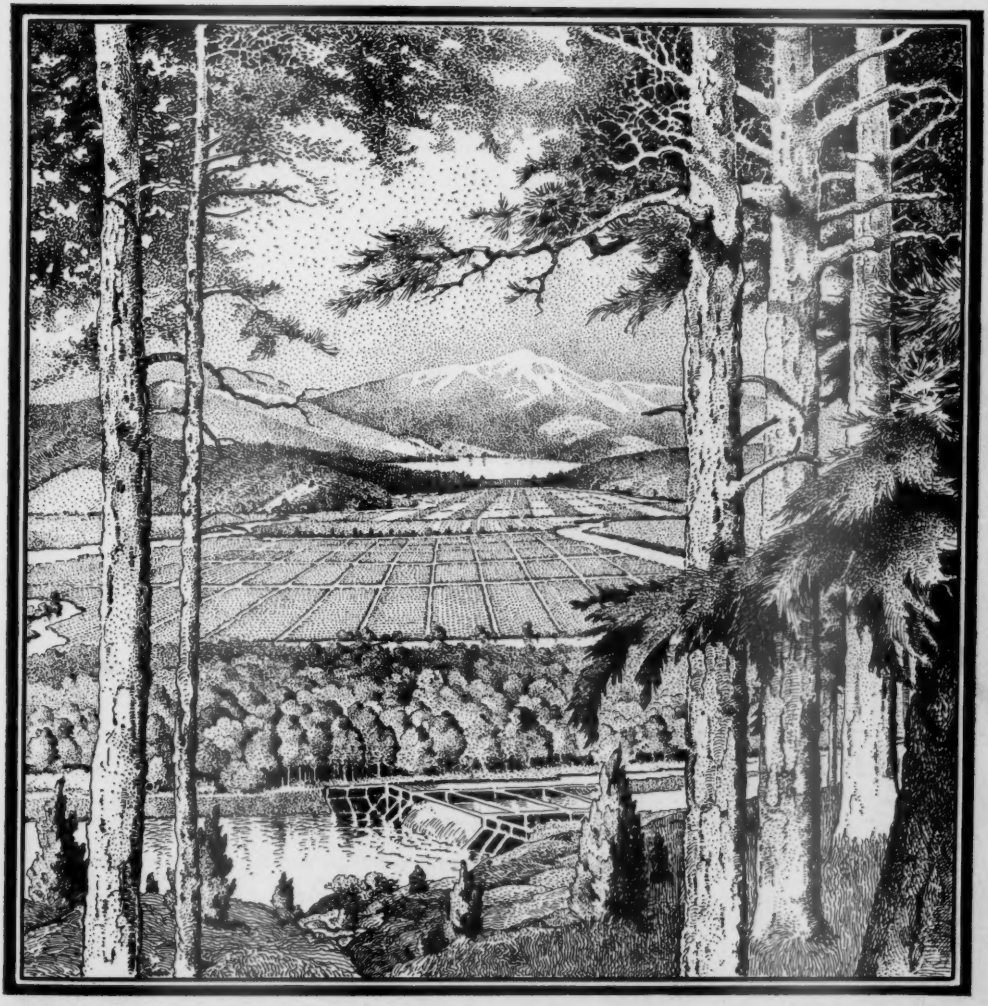

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The objects of the Association, as set forth in its Constitution, are as follows:

1. The adoption by the Federal Government of a permanent policy for the reclamation and settlement of the public domain, under which all the remaining public lands shall be held and administered as a trust for the benefit of the whole people of the United States, and no grants of the title to any of the public lands shall ever hereafter be made to any but actual settlers and homebuilders on the land.

2. The preservation and development of our national resources by the construction of storage reservoirs by the Federal Government for flood protection, and to save for use in aid of navigation and irrigation the flood waters which now run to waste and cause overflow and destruction.

3. The construction by the Federal Government of storage reservoirs and irrigation works wherever necessary to furnish water for the reclamation and settlement of the arid public lands.

4. The preservation of the forests and reforestation of denuded forest areas as sources of water supply, the conservation of existing supplies by approved methods of irrigation and distribution, and the increase of the water resources of the arid region by the investigation and development of underground supplies.

5. The adoption of a harmonious system of irrigation laws in all the arid and semi-arid states and territories under which the right to the use of water for irrigation shall vest in the user and become appurtenant to the land irrigated, and beneficial use be the basis and the measure and limit of the right.

6. The holding of an annual Irrigation Congress, and the dissemination by public meetings and through the press of information regarding irrigation, and the reclamation and settlement of the arid public domain, and the possibilities of better agriculture through irrigation and intensive farming, and the need for agricultural education and training, and the creation of rural homes as national safeguards, and the encouragement of rural settlement as a remedy for the social and political evils threatened by the congestion of population in large cities.

Forestry and Irrigation

H. M. SUTER, Editor and Publisher

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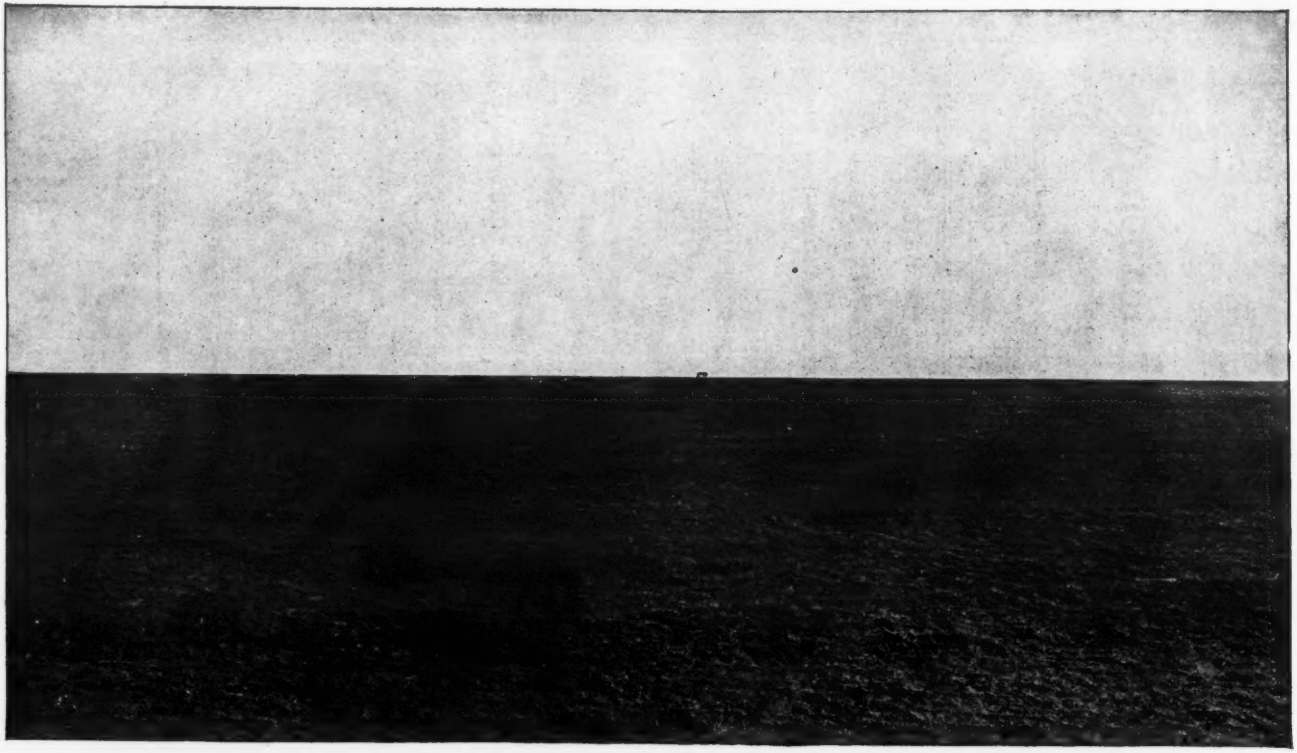


SCENE ON THE FLAT UPLANDS OF THE WEST. LACK OF WATER PREVENTS THE UTILIZATION OF THIS LAND.

Forestry and Irrigation.

VOL. VIII. MAY, 1902. No. 5.

NEWS AND NOTES.

Vacation Notice to Subscribers. Subscribers desiring to receive FORESTRY AND IRRIGATION at their vacation addresses will oblige us, and save themselves annoyance, by sending us notice of any changes in their addresses two weeks prior to the date they are to go into effect. Similar notice should be given when subscribers are returning to their permanent addresses. FORESTRY AND IRRIGATION is published on the fifteenth of each month.

Forestry at West Point. In the early part of April the War Department made application to the Agricultural Department for a forester to superintend some improvement cutting along the Hudson River front on the West Point Military Reservation. Mr. Wm. L. Hall, Superintendent of Tree Planting, took up the work, and, in connection with it, at the request of Col. A. L. Mills, Superintendent of the Military Academy, made a preliminary examination of the woodlands on the reservation with a view of suggesting plans for their improvement.

Of the 2,300 acres comprising the reservation, the part not occupied by buildings or drill-grounds, from 1,800 to 2,000 acres, is of mountainous character and covered by second-growth hardwood timber 30 to 40 years old. A limited amount of this timber has been cut for use in fences, bridges, and for telephone poles. The greater part consists of a dense, unthinned stand, with some windfalls and some timber injured by fire.

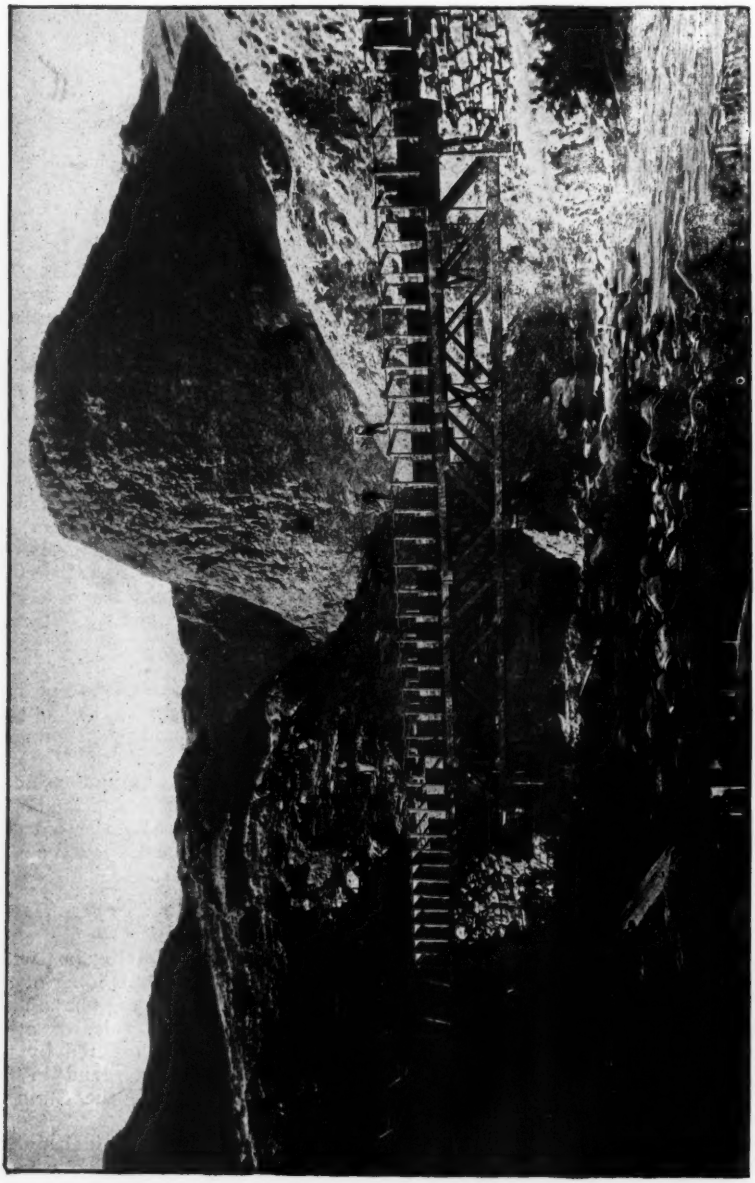
All the woodland is in need of a specific plan of management which will provide for thinning, the removal of the dead and down timber, and protection from fire.

The authorities of the Academy are desirous of developing the woodland to its greatest value and beauty, and also of improving the whole reservation by extending the system of roads and by the formulation of a plan to beautify the parts of the reservation now used by the Academy. To quote from a letter from Mr. Gifford Pinchot to the Secretary of Agriculture: "A plan for the reservation should be a joint undertaking for the landscape architect, the civil engineer, and the forester. A highly satisfactory arrangement for the undertaking would be through a joint commission consisting of a civil engineer from the Army, a landscape architect secured by the War Department, and a forester from the Bureau of Forestry. A careful plan worked out by such a commission should be of immense value to the reservation."

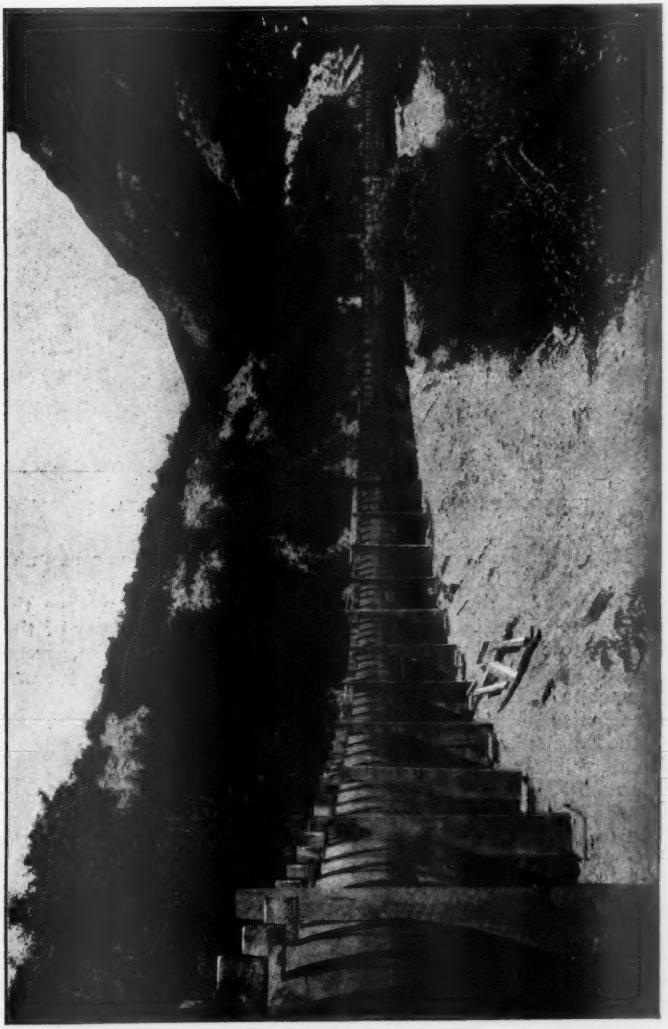
This proposition is being considered by the Secretary of War and the Secretary of Agriculture, and the outcome may be the appointment of such a commission.

St. Mary Reservation. On April 5 the Secretary of the Interior instructed the Commissioner of the General Land Office to temporarily withdraw from entry, sale, or other disposal, until further ordered by the Department, the public land in the following townships in the State of Montana:

T. 27 N., R. 6 to 12 E., inclusive.
T. 28 N., R. 5 to 13 E., inclusive.
T. 29 N., R. 4 to 13 E., inclusive.
T. 30 N., R. 3 to 13 E., inclusive.
T. 31 N., R. 6 to 13 E., inclusive.



CONVEYANCE OF WATER FOR IRRIGATION IN FLUMES. VIEW OF NORTH POUDRE FLUME NEAR GREELY, COLORADO, 300 FEET BELOW DAM, SHOWING CANAL CROSSING THE STREAM FROM WHICH ITS WATERS ARE TAKEN.



SIDE VIEW OF STERLING SEMICIRCULAR FLUME IN PROVO CANYON, UTAH.

FLUME CROSSING A RAVINE AT SANGER, CALIFORNIA.

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T. 33 N., R. 9 to 16 E., inclusive.
T. 34 N., R. 9 to 16 E., inclusive.
T. 35 N., R. 9 to 16 E., inclusive.
T. 36 N., R. 9 to 11 E., inclusive.

This action was taken in accordance with the suggestion of Hon. Paris Gibson, Senator from Montana, dated January 7, that the Department temporarily withdraw lands which may be watered by the proposed St. Mary reservoir and diversion canal. Senator Gibson's first request embraced a larger area than that given above, extending from the Blackfeet Indian Reservation easterly and including 157 townships, or in round numbers, 3,600,000 acres, about 5½ per cent of the vacant public land of the state. It was objected that this reservation was too extensive, and after careful consideration it was reduced to 77 townships, including the most important land, this being in round numbers 1,800,000 acres. Some of the land within this area has already been filed upon, but the total amount is less than 2½ per cent of the vacant public land of the state.

It is proposed to reserve this land pending a careful survey of the canal route from St. Mary Lake, several alternative propositions being under consideration.

Death of J. Sterling Morton.

The Hon. J. Sterling Morton died in Chicago on April 27, 1902, and was buried at his home, in Nebraska City, Neb. He was near his seventieth birthday when he succumbed to the disease against which he had vainly struggled for months in the hope of recovery.

Mr. Morton was a man of strong personality, and possessed in a remarkable degree a desire to serve the best interests of his state and its people. He was best known in his public life as acting Governor of Nebraska and as Secretary of Agriculture from 1893 to 1897. Intense practicality characterized his ad-

ministration of the latter office, in which also the courage of personal convictions in matters of duty was constantly felt. His practice of rigid economy in the disbursement of the public funds for which he was accountable was also a marked feature of his administration as Secretary of Agriculture.

Living on the great treeless plains of the West, Mr. Morton early developed the keenest interest in forest-tree culture as one of the great needs of the West. He encouraged tree planting by public addresses, by his writings, and by a most notable example of successful tree planting and the profitable management of the resulting woodlot at his Nebraska farm home.

His unusual efforts in behalf of tree planting leaves Nebraska the lasting honor of being the first state in which Arbor Day was observed. He was the originator of the idea of observing an annual Arbor Day, and through his efforts Nebraska celebrated the first Arbor Day observed in the United States, in 1872. The annual observance of this day by Nebraska schools has resulted in the planting of millions of forest trees in that state. Other states have followed Nebraska's example, until now Arbor Day is observed in practically every state and territory in the Union. J. Sterling Morton will long be remembered in the Middle West as the "Father of Arbor Day."

Irrigation in Alabama. From the census bulletin it is learned that "irrigation does not as yet occupy a very important place in the agricultural development of Alabama. But with the increase in acreage devoted to the growing of early vegetables for northern markets, its practice will doubtless become more general, as it affords an insurance against the short but destructive periods of drought which frequently occur in the spring. In 1899 89 acres were irrigated. The products, principally vegetables, were valued at $10,758, or $121 per acre. The cost of constructing the wells, pumps, tiling, and ditches now in use is estimated to have been $5,200."

New Forest Reserves. On the 16th of April two forest reserves were established by presidential proclamation in the sand-hill district of Nebraska. One, to be known as the Dismal River Reserve, is situated between the Dismal and Middle Loup rivers, just above their confluence, and contains 86,000 acres; the other, to be called the Niobrara Reserve, occupies a similar position between the Niobrara and Snake rivers and contains 125,000 acres.

These reserves lie near the center of the great sand-hill district, which includes 15,000,000 acres, or nearly one-fourth of Nebraska. The country is characterized by many ranges of wind-formed dunes, separated by small depressions. In the past, while the hills were being formed, the whole country was barren, and even within the memory of men now living it contained much shifting sand and but a sparse cover of grass and shrubs. Since the settlement of the surrounding country improved protection from fire has allowed vegetation to increase rapidly, until now there is generally a fair cover, the only barren places being the so-called "blow-outs"—places in the hillsides where wind erodes the sand when the cover is once destroyed.

Many shrubs, such as Wild Plum, Choke Cherry, Wild Grape, Sand Cherry, and Poison Ivy, have gained an entrance in recent years. Such shrubs in the eastern part of the state are the first to spring up on land that is passing into forest growth, and in the sand-hills they seem to be the forerunners of trees in just the same way. The increase of shrubs is an indication of the strong tendency of the region toward forest growth.

The only timber which ever grew on the reserves was along the streams mentioned as forming the boundaries. Most of this has been cut away on account of the great demand for fuel and timber of all sorts; but where any of it has been left the reproduction is astonishing. In some places, especially along the Niobrara River, the young pines are spreading far out into the sand-hills, and if let alone will of their own accord in

VIEW IN SAND-HILL REGION OF NEBRASKA.

time steal large areas from the prairie. The main purpose of these reserves, however, is to try on a large scale the practicability of forestation. Every condition seems favorable. It is proved beyond question that the region is adapted to the growth of pine timber. The need of timber in the region is so great that there will be a demand for every stick which can be produced, while for other purposes the land is practically valueless. The main question hinges upon the development of a practicable and economical method of getting the forest started. If that difficulty can be surmounted the success of the undertaking will be all but assured.

The establishment of these reserves marks a distinct step in our national forest policy. It is the first attempt of the government to reclaim worthless land by forestation. It is likewise the government's first attempt to establish artificial forests in regions where natural forests are wanting. By this act, if it shall prove successful, the government really pledges itself to a policy of improvement of its non-productive land where it can be done advantageously by forestation.

On account of their unique purpose, the Nebraska forest reserves are certain to attract widespread attention.

On April 11 the San Isabel Forest Reserve, containing 77,980 acres, located in Saguache and Custer counties, south central Colorado, was formally established on a proclamation by President Roosevelt. A few days later, on April 16, the San Francisco Mountains Forest Reserve was increased in size by 999,950 acres, making the total area of this reserve 1,975,310 acres.

The total area of all forest reserves in the United States is now 48,002,101 acres.

Forest Fires. Since the publication of the April number of FORESTRY AND IRRIGATION there have been forest fires in twenty-two states, from **Maine** to **Colorado.** The amount of property destroyed has been unusually great for a single month, and in addition several lives have been lost. The fire record is as follows :

Pennsylvania.—During the last week in April there were many serious forest fires in the central part of this state. Near Sinnemahoning two men lost their lives in a forest fire, while at Clintondale one life was lost, and the fire also destroyed ten houses, a church, and a school-house. In the vicinity of Haneyville, Lycoming County, 400,000 feet of sawed lumber and four houses were burned. In addition to these losses there were fires at Ridgeway, Ramseyville, and in the vicinity of the Williamsport Water Company's reservoir.

Forest fires near Oil City on April 25 destroyed $30,000 worth of property in a single day, a number of derricks were burned, and much damage was done to virgin forest near Tionesta. On the same day a forest fire swept over 2,000 acres on South Mountain, land recently added to the state forest preserve; 1,800 acres on North Mountain were also burned over. Near Laurel Run 1,000 acres of timber were burned over on April 24. There are also reports of destructive fires from Beaver Falls, Franklin, Altoona, Shamokin, Danville, Normalville, Stroudsburg, Lancaster, and Shenandoah.

Kentucky.—Forest fires in Christian and Hopkins Counties during the last week in April caused $15,000 damage. From Mayking, Martindale, Scottsville, London, and Owingsville come reports of severe fires, with much loss in the way of houses, barns, fences, and standing timber.

New Jersey.—Forest fires in this state are reported from Elwood, Belvidere, Glassboro, Ocean City, Minotola, Cedar Brook, Blue Anchor, and Brookline, 12,000 acres of timber being destroyed.

Maryland.—A forest fire between Edgemont and Blue Mountain destroyed $15,000 worth of property on May 1. The most destructive forest fires in years have been burning in the Blue Ridge range of mountains. Serious damage by fires is also reported from Catoctin Furnace, Cumberland, Ritchie's Station, Towson, and Hagerstown.

From many other states come reports of fire. **Indiana,** a state of small forest area, had fires near Franklin, Otisco, Hartford City, St. Peters, Anderson, Summitville, Seymour, Nashville, and South Bethany. In **New York** on May 9 one thousand people were engaged in a battle with a forest fire which threatened to destroy the town of Babylon, L. I. **Wisconsin** had two severe forest fires during the past ten days, while in **Tennessee** during the same time there were six fires that damaged property to the extent of $10,000.

Since April 15 there have been seven forest fires in **Virginia,** two in **Illinois,** two in **Connecticut,** one in **Minnesota,** four in **West Virginia,** and two in **Colorado.**

There must also be added to this list forest fires in **Maine, Texas, New Hampshire, Iowa, New Mexico, North Carolina,** and **Ohio.** Altogether the early spring forest fire record is unusually large.

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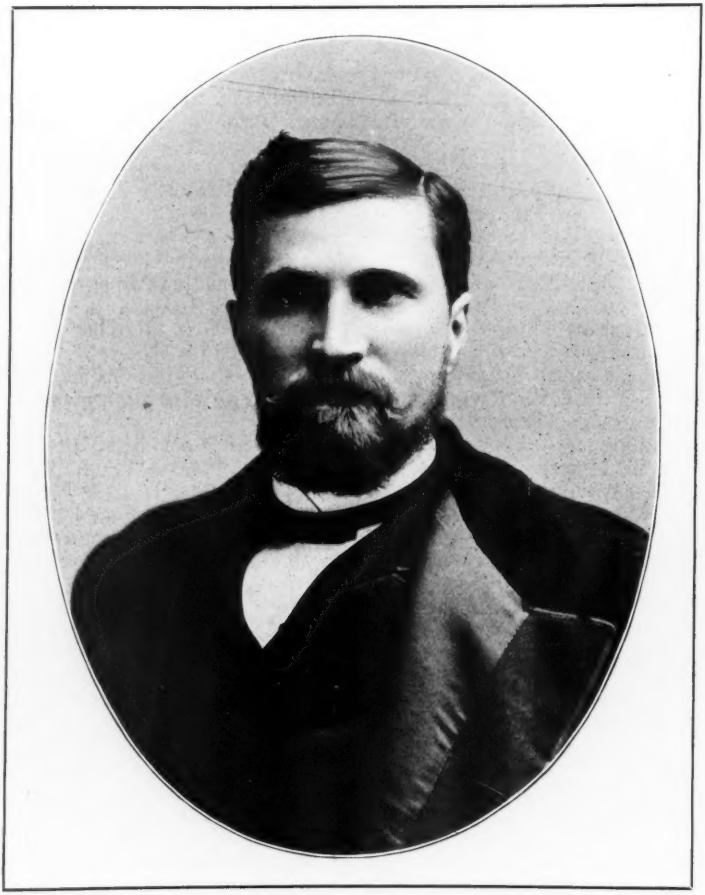


HON. THOMAS C. MCRAE.

HON. THOMAS C. McRAE has for a number of years been one of the most indefatigable advocates of a practical, business-like administration of the forest reserves of the United States. To his energy is largely due the enactment of beneficial legislation regarding national forest reserves. He has long been an active member of the American Forestry Association, and has served as vice-president for the State of Arkansas. Mr. McRae was born at Mt. Holly, Arkansas, in 1851; was educated mainly at private schools; worked on a farm and in business houses. He graduated in law at the Washington and Lee University, Virginia, in 1872; was admitted to practice in the state circuit courts in the following year, and was elected to the Forty-ninth Congress, being reëlected eight times in succession. He is thus among the oldest members of the House and is now serving upon the important Committee on Appropriations.

ADMINISTRATION OF U. S. FOREST RESERVES.

By Filibert Roth,
Chief of Division R, General Land Office.

PART I.

THOUGH the first federal forest reserves were created as early as March, 1891, there were no laws or appropriations made for their care until June, 1897. At this time twenty-nine reserves were in existence, with a total area of nearly 26,000,000 acres. The act of June 4, 1897, provided for an administration, but failed to supply the funds, and only $18,000 were available for the care of reserves for 1897–1898.

During this first year nothing more than a few field agents could therefore be employed, and the care of the reserves was practically the same as before. Nevertheless, the administration of the reserves, intrusted to the General Land Office in its special-service division, was organized, and a set of rules and regulations was prepared and published June 30, 1897, which are in force to-day and have proven quite satisfactory.

As soon as funds were provided, a field force was organized in the form now in existence. After nearly three years of experience and after the business of the reserves had become rather extensive, a separate division was created (Division R) to assume charge of the reserve work. When fully organized, this administrative bureau consisted of several subdivisions, each attending to a particular branch of the service, such as appointment and distribution of the field force, sales of timber, "free use" of timber, special privileges, such as rights of way of roads and railways, establishment of mills, hotels, etc.; grazing, lieu-land selections, and the creation of new reserves and elimination of lands from reserves already in existence.

The field force, as organized in the beginning, consisted of *rangers* or guards, usually several to each reserve; one *supervisor*, in a few cases two, to each reserve; *superintendents* having jurisdiction over all the reserves in the particular state or territory, and one *inspector* to look after all reserves. According to this scheme, the ranger reported to the supervisor, the supervisor to the superintendent, and this officer to the central office at Washington.

The rangers were paid $60 a month, and each assigned to some particular beat or district. They were required to keep a horse and camp outfit, keep a record of each day's work, and report the same as a "report of daily service" at the end of each month. This report was examined and approved by the supervisor, transmitted to the superintendent, re-examined and approved, and then sent to the central office. The same procedure was required for reports other than service, such as statements concerning sales of timber, free use of timber, grazing, trespass, etc.

The supervisor was manager of his particular reserve, but all orders to him and all reports from him naturally passed through his superior, the superintendent. In his powers he was (and is yet) quite limited. He had no right to incur expenses other than for travel and in cases of emergency, such as forest fires.

The superintendent acted as director, originated and transmitted orders, transmitted and approved reports and accounts, and acted as local inspector, examining personally conditions of the reserves and the work performed. In addition every superintendent was frequently called upon to do duty in other directions by making special examinations of lands to be reserved or to be eliminated from existing reserves, examining into the status or *bona fides* of agricultural claims, of mining claims, etc.

The greatest difficulty in the organization of this service lay naturally enough in the lack of good men to be had at the small salary and for only a few months in the year. To increase the difficulty, it was insisted upon by local interests to select from home applicants. The prevailing idea naturally was that any man could "ride range," as it was called, and that therefore any man should answer. Very much the same ideas existed among applicants for the position of supervisor. That any of these men should at least be competent woodsmen, able to survey and estimate the timber to be sold or to be given in cases of "free use;" that they should understand a log or wood contract, and thus guard against mischievous errors; that they should be able to scale timber, and to keep intelligent record of the woods business of the reserve—all these things seem never to have entered the minds of many who presented themselves for positions or of those who recommended the many candidates. The idea of providing competent foresters, who should have trained judgment to assist them in deciding whether a given tract of difficult, protective forest may be cut over or not, could not be entertained, for the simple reason that the foresters did not exist.

It was necessary, therefore, to move carefully. The men required persistent instructions with regard to every detail of law and of business, and it was necessary to use every possible means of surveillance to avoid neglect of duty, intentional or otherwise.

For the fiscal year 1898–1899 Congress appropriated $200,000; for the last three years $300,000 per year. During the year 1900–1901, with 39 reserves to look after, the field force, when at a maximum, consisted of one inspector, 9 superintendents, 38 supervisors, and 435 rangers. During the winter months of each year, when most of these high-mountain forests are covered with snow and there is practically no danger from fire or other mischief in most parts of the reserves, the force was reduced, so that, for instance, in December, 1901, nearly half the reserve areas were without either supervisor or ranger. This reduction of the force was not so much one of policy, but rather one of necessity, the appropriation being entirely inadequate to cover so large a territory.

This condition, the need of larger appropriations, is not well appreciated generally, for but few people seem to realize that there is more to do than merely patrol these mountain woods. Some of the reasons for an increased appropriation were set forth as follows in making up the estimates for the year 1902–1903, in December last:

1. The present fund barely suffices to give the reserves an adequate fire patrol during the summer (danger) months.

2. It was necessary to reduce the force during the winter (the timber-cutting season) and leave even some of the best forest districts without protection.

3. Delays in the timber business and consequent trespass and dissatisfaction were caused by a lack of help, and especially a lack of competent help, which made it impossible to supply mining and milling concerns and hundreds of settlers with the necessary timber, although suitable material in abundance is ready for the axe.

4. The small pay offered the rangers has been insufficient to secure men of experience, particularly men versed in the timber business.

5. Proper inspection and the assistance of technically trained men had to be dispensed with, owing to a lack of funds.

6. Proper forest surveys and the permanent regulation of the forest business of the reserves are impossible without men of technical training, and without such regulation the business will always be in an unsatisfactory condition, much to the detriment of the reserves and the people having to do business with the reserves.

7. Additional reserves being created each year require additional help.

8. The business of every reserve naturally grows with every year in proportion as additional settlement and the development of mining and other industries increase the demand for timber and other resources of the reserves.

As a striking example of how rapidly the relations of these reserves with the surrounding people are multiplying, it may be stated that while in the year 1900–1901 there were but ten cases of "free-use" applications for timber in the Lewis and Clarke Reserve, there were over three hundred such cases attended to from July 1, 1901, to March 31, 1902. In the same way the cases of sales of timber are steadily and rapidly increasing. The possible magnitude of the business of these reserves may be inferred from the fact that the annual growth of timber over these areas amounts to at least two billion feet, that enough grass is produced to warrant at the present day the pasturing of over a million head of domestic animals, and that the mineral wealth largely dependent for its exploitation on these reserve forests, though reckoned by millions, has "hardly been scratched."

A NOTABLE CALIFORNIA FIR.

ABIES VENUSTA, KOCH.

By William Russel Dudley,

Professor of Botany, Leland Stanford, Jr., University.

THIS remarkable representative of the Fir type of the *Coniferæ* is confined to the western part of Monterey County, California, in a portion of those rough, scarcely explored ranges of government lands known as the Santa Lucia* Mountains. When noticed at all by the local residents it is called the "Silver Fir" or "Silver Pine," and to distinguish it from the Silver Fir of the Sierras (*Abies magnifica*), with which some of the inhabitants confuse it, it should be called the "Santa Lucia Silver Fir."

It is a tree of singular beauty. Its foliage resembles that of *Torreya*, dark green above when mature; its leaves are coriaceous, shining, and exceedingly prickly pointed. The tree is not large, rarely over 75 or 100 feet in height, but its outline is like no other conifer. Its very long, slender spire and its swelling outline toward the base, abruptly contracting near the ground; its situation, usually springing out above some bold rock on a river bank or inaccessible mountain crag; its foliage whitish below and dark green above, render it a most striking object.

It is like a fir only in the character of its erect cones on the upper fertile branches, and it surely has had a different line of descent from any of the other species of *Abies*. It is the only living representative of its type. With the Monterey Cypress, the Torrey Pine, and some other *Coniferæ*, it gives to the coast ranges of California an absorbing interest in the mind of the student of descent and geographical distribution.

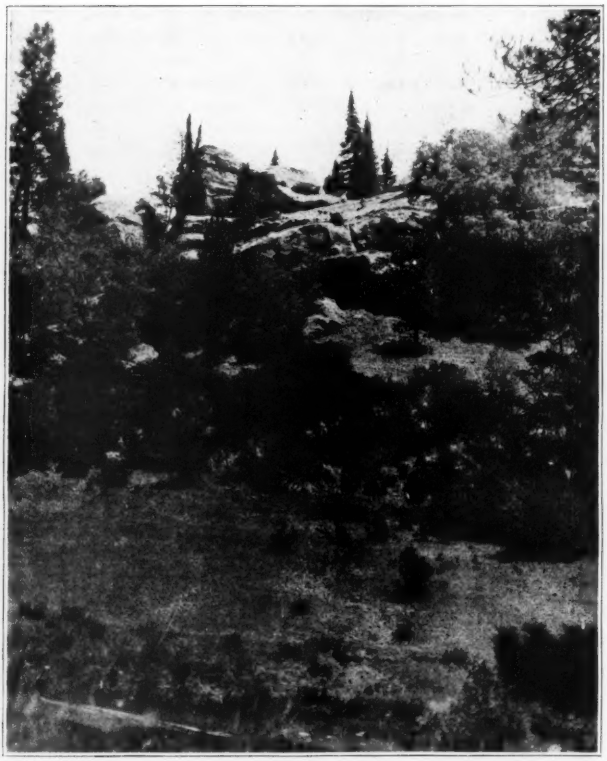
This paper intends to set forth briefly two somewhat important facts in connection with this species:

First. That its range, through the author's personal explorations during the past year, is much more extended and its members much greater than were before supposed.

Second. That with this extension of its range over the mountain mass of the northern Santa Lucias, and the headwaters of several rivers, the species is seen to have an economic bearing on the question of protection of these river sources.

Concerning the rarity of this species and its distribution, as understood previous to this year, I cannot do better than to quote from Sargent's Silva, vol. xii (1898): "Of the species of *Abies* now known, no other occupies such a small territory; for it grows only in a few isolated groves, the largest contain-

* "Lucia" is pronounced Lu-sée-ah, the accent on the second syllable—the *u* as "*oo*," the *c* soft.



THE SILVER FIR GROWING AMONG SANDSTONE ROCKS NEAR UPPER CARMEL RIVER, CALIFORNIA.

ing not more than 200 trees, scattered along the moist bottoms of canyons, usually at an elevation of about 3,000 feet, on both slopes of the outer western ridge of the Santa Lucia Mountains of Monterey County."

Sargent then mentions four canyons near the Pacific, in the southern part of the county, where the species is known to occur. My own knowledge of it in this part of the county corresponds substantially with his record. In other words, it was supposed by recent botanists to occur only at these four or five stations, about five miles from the ocean, over a region less than 25 miles in length. In this region too, it will be observed, that it was reported *only* from canyons.

From the explorations of the past year, in the much more extensive, rugged, and elevated masses of the northern Santa Lucias, it is found that its range may be extended for over 50 miles from north to south; that it occurs at least 18 miles eastward from the ocean; that its favorite habitat is crag, rocky ridge, and slope, although it occurs in canyons and along streams. Instead of growing at about 3,000 feet elevation, it ranges in this region, its true home, from 1,500 to over 5,000 feet above the sea.

Although not pertinent to this paper, I will refer to the fact, to be treated more fully elsewhere, that this extension of the range is in part a rediscovery of the locality of the species mentioned by Lobb in 1853, who refers to it as "growing on the highest peaks and most exposed places, in slate which to all appearances is incapable of supporting vegetation." Sargent, in commenting on the above, says: "Since Lobb's time, fire has probably destroyed all the trees except those which were protected by moisture in the bottoms of the deepest canyons." As a matter of fact, although fire has ravaged these regions with unparalleled fury, the truer explanation of Lobb's puzzling passage would suggest that Lobb never saw the trees which modern botanists believed to be the only ones in existence; and strange as it may seem, the latter did not know of the trees found by the former. Coulter, Lobb, and Douglas all entered these mountains from Monterey, which lies to the north of them, and undoubtedly saw the northwest portions of the area

of their northern extension. In regard to the relative numbers in the two sections, I should say that where the southern extension might number its trees by the hundreds, in the northern they might be numbered by the tens of thousands.

The writer feels confident of having completely outlined their area of distribution, and in so doing his ideas of their climatic and ecological affinities have changed. From the fact that they were found in the southern mountains, but little higher in the canyons than the redwoods, and were only a few miles from the ocean, he was led to infer that they belonged with the redwoods to the fog-belt of the coast ranges. It is now clear that they do not belong to that belt, and consequently not to those stream basins west of the westernmost coast range, but belong to the ranges next within, which have abundant precipitation, but are semi-arid in summer, and which give rise to streams whose flow, though often uncertain, is important to several towns and a rich valley—the Salinas—of this region.

This brings us to the second part of this paper—the economic aspects of the distribution of the *Abies venusta*. In regard to the southern extension of the species—south of the latitude of Santa Lucia Peak, the highest point of these mountains—I should say that it is at present only of the slightest importance to the protection of the stream sources of the Naci-mi-én-to, one of the three chief branches of the Salinas River. Quite probably, however, if this region was protected from fire, and the *Abies venusta* extensively propagated in this basin, which must be well adapted to it, it would insure the steady flow of this uncertain stream.

To understand its economic relation in the northern extension, it is necessary to explain that it occupies here practically a triangular area, whose eastern angle reaches back at least 18 miles from the coast among mountains often over 4,500 and 5,000 feet in elevation, largely covered with chaparral, but in favorable localities producing considerable tracts of *Pinus ponderosa*, *Pinus*

THREE SILVER FIRS IN LOST VALLEY THAT ESCAPED THE GREAT FIRE OF 1898. THE DEAD TREES ARE QUERCUS CHRYSOLEPIS.

coulteri, and *Abies venusta*, only the first named creating the effect of a forest. With these are mixed the Black Oak, Valparaiso Oak, Tanbark Oak, and Madrone.

From the northern Santa Lucias spring three streams of considerable size, beside the smaller ones flowing toward the Pacific. The first of these three is the Sur* River, draining the western slope of the outer range; it has a considerable body of Redwood at lower elevations, and scattered groves of the Silver Fir on the high rocky ridges, and flows northwestward into the Pacific.

MARGIN OF WOODS IN BEAR BASIN, SANTA LUCIA MOUNTAINS, SHOWING SPECIMENS OF SILVER FIR, COULTER'S PINE, LIBOCEDRUS, AND PINUS PONDEROSA.

The second is the Carmel River, draining the north slopes of this mountain mass. In this irregular drainage occur most of the groves of *Pinus ponderosa*, and the largest areas occupied by the Silver Fir, besides considerable Tanbark Oak,† Madrone, and Valparaiso Oak.‡ Much of the mountain portion of this drainage indeed appears to bear a true forest. Here also, in Bear Basin and Ventura Creek, *Abies venusta* appears at its best. It nowhere shows a tendency to a forest, but occupies either the rocky faces of steep canyons, the crests of rocky ridges, or bottoms of the canyons; always scattered, or in groups of from three to ten or twelve, with the rocks or other trees interspersed. Its preference is the north slope or the vicinity of a mountain stream. Its roots evidently seek the moisture found in these situations.

The waters of the Carmel are of growing importance, as they furnish the towns on Monterey Bay, such as Pacific Grove, Monterey, and Hotel del Monte, with their domestic water supply.

The third stream is the Arroyo Seco, one of the three chief branches of the Salinas River. The Arroyo Seco drains eastwardly, rises in the heart of the northern Santa Lucias, and its watershed occupies a greater share of their territory. The ridges are of great steepness, the canyons sometimes impassable and the elevations of a greater share of its mountains from 3,000 to 5,500 feet above the sea, Santa Lucia peak, on its southern boundary, rising to a height of 5,967 feet. A great deal of this basin is covered with chaparral, with a limited amount of hardwood timber on the north slopes, some *Pinus coulteri*, and occasional tracts of the Silver Fir, which becomes rather common in the northwestern part of the basin, where the waters approach the sources of the Carmel and the Sur. In this basin there would be much more timber than exists at present if forest fires of great destructiveness had not repeatedly swept its steep mountains. These fires are known to have been set purposely in some cases. I have photographs of Silver Firs destroyed by the fire of 1898; but the greatest destruction was among the

* Pronounced "Soor."
† *Pasania* (or *Quercus*) *densiflora*.
‡ *Quercus chrysolepis*.

THE SILVER FIR ALONG THE UPPER CARMEL RIVER, CALIFORNIA; A SPECIMEN OF PINUS PONDEROSA IN THE CENTER.

oaks. *Pinus ponderosa* 2 feet in diameter were killed, and the *Pinus attenuata*, which is supposed in southern California to resist and check forest fires, was burned into the roots and destroyed.

The Salinas Valley is a very rich valley, and is the center for the sugar-beet industry in northern California. Water has been sought at considerable expense through pumping plants, which have not been very successful, I am told. So important is the water supply for this valley that, in 1900, the Arroyo Seco was selected as one of the first basins to be examined by engineers under the authority of the United States Government and the California Water and Forest Association, and several sites for storage reservoirs were mapped.

The engineer in charge proposed that I look over the forest conditions of the Arroyo Seco. I have now acquainted myself with the character of the whole, and the actual growth of more than half the basin. A few of the results of the work have been set forth in this paper, one of the most interesting of which, to a botanist, was the discovery that *Abies venusta* occupied not infrequent areas in this and the Carmel River drainage, and might under proper care become an important factor in the question of the conservation of an abundant rain and snow fall.

Therefore, in closing, let me suggest certain conclusions which seem pertinent to me: If the Arroyo Seco is to have storage reservoirs, holding a water supply gathered from very steep slopes, with a consequently rapid drainage, the protection of the existing ligneous growth and the propagation of additional forest growth within this basin is the rational accompaniment of the engineering work.

Fire must be kept out, and I am satisfied that the Silver Fir would be one of the best species to encourage or to propagate over certain large, rocky tracts where few other trees naturally grow. The best hardwoods to accom-

pany it would be the Tanbark and Valparaiso Oak—the two oaks economically most valuable on the coast.

Furthermore, the water supply from the Carmel River will soon become inadequate or inferior for the growing seaside towns on Monterey Bay, if the same protection from fire is not accorded to the woods at the head of the stream.

In this protection of the Carmel and the Arroyo Seco, one of the most interesting conifers in the world, the Silver Fir of the Santa Lucias, would be cared for in its original home.

RESULTS OF IRRIGATION IN WISCONSIN.

By George H. Patch.

THE method of irrigating our garden bed of matted strawberries is simply to lay a sluice hose along the upper edge of the piece, open a few ports at a time and let the water flood as far as it will in a short time, then open more ports and close the first, and so on, till the whole strip is watered; then move the hose out onto the plants to the farther edge of the watered strip and repeat the operation till the whole is watered.

A large percentage of the plants first set in this bed died, and the remaining ones were allowed to make runners to furnish plants to fill in missing spaces. Through neglect the whole became more or less matted over. We intended to run furrows for irrigating, but it seemed a pity to tear out so many nice plants, and it was not done. Next time we will run the furrows, or rather we will allow no more beds to mat, so that pickers will have something besides berries to walk on. I mention this method of irrigation because raspberries or other small fruits mulched with straw could be irrigated in this way without moving the straw, by laying the hose on top of the mulch, letting the water sink through and spread under it.

Under the direction of Professor King about fifteen acres were laid out into ten plats of about one and one-half acres each, the main crops to correspond in size to these plats, which were again subdivided into a total of forty-eight subplats. Alternate subplats were left unmanured, and part of those manured received twice as much manure as the

ILLUSTRATION SHOWING THE FLOW OF WATER THROWN BY THE PUMP USED BY MR. PATCH.

others. One-half of each subplat was irrigated, some of these once a week and some once in two weeks. A laboratory was fitted up in the pump-house in which soil samples were analyzed for their water content and their soluble nitrates. Two men were kept busy during the season taking soil cores (in foot lengths, to a depth of four feet, by driving down a brass tube and pulling it up with the soil inside) and conducting the analyses. These soil samples were taken in certain rows and furrows just before each irrigation and at intervals after irrigation and the movements of water and nitrates closely followed. Many hundreds of soil samples were thus analyzed during the summer.

I am not in possession of the results of these experiments in detail, and if I were I could not use them in this connection, as the government reserves the right of first publication of its findings. I may, however, state some well-known facts concerning the irrigation of sandy lands. In the case of such porous soil and open subsoil (pure sand) as we have to deal with, water passes down rapidly, and if too large an amount is applied there is more or less leaching of the nitrates (plant foods) from the soil into the soil water below and carried through springs into the rivers, where they are mostly taken up by water weeds, or liberated by denitrifying organisms in the water and the nitrogen returned to the air.

Well water, especially in such soils, is therefore very much richer in nitrates than river water, and therefore much better suited to maintaining fertility in the soil, as a part of the nitrates which have been leached out of the soil may be pumped up and returned to it in a form all ready for plants to use. We got better results from our garden irrigation with well water than from our field irrigation with river water, due partly, no doubt, to leaching in the field by applying too large quantities of water, and partly to the difference in nitrate content of river and well water. Where conditions are favorable, therefore, the well and windmill or other suitable power cannot be outdone for small areas, and I am not sure that many wells and small systems of irrigation may not be preferable to one large plant using river water on a large area.

In case an engine or horse-power is used to pump from a well, hose may be attached directly to the pump and the water allowed to run into furrows; but with a windmill a pond is necessary to accumulate water enough to pay to attend to running it. Wind is too unsteady a power to allow it to pump directly into furrows, as it would require constant attention to secure an equal and economic distribution of water.

The muck soil of swamps and marshes which fringe many of our rivers is made up largely of decomposed water weeds

THIS CUT SHOWS WATER RUNNING IN THE FURROWS, WITH THE SLUICE HOSE IN THE FOREGROUND.

and grasses, the accumulation of ages, in which much of the nitrogen which would otherwise have been carried to the sea has been rescued and stored up. The river from which we pump is fringed by such a deposit, two feet deep and several acres in extent between our pump and the river bed. It occurred to me that it would be possible to stir much of this muck (made soft by partial overflow from a mill-pond below) into the water and pump it up onto the land, and thus add humus to the sand and upon which the upland bacteria could work, gradually making the stored nitrogen available for plant food.

HOME-MADE COTTON-DUCK HOSE FOR CONVEYING WATER, SHOWING OUTLETS AT THE HEADS OF FURROWS.

We fitted out our engineer with hip-high rubber boots and a six-tined fork and had him stir mud when not needed at the engine. We found the mud made the hose more nearly water-tight, and that it did not settle in the hose, as we feared it might, nor in the furrows, except the most level portions, where it gathered to a depth of one-fourth of an inch or more. This is then cultivated into the soil. Strawberry ground treated thus is becoming darker in color and plant-growth more vigorous than on those portions where no muck settles. It will be necessary to add potash and phosphate fertilizers to make a well-balanced soil, as muck contains comparatively small amounts of these elements. Professor King had a measured amount of muck added to a small area of soil, analyzing samples of this soil from time to time to determine how much the development of nitrates was affected by the addition of the muck.

One advantage of having muck stirred into the water is that it silts up the bottom of the furrows, checking the downflow and forcing more water out of the sides toward the plants.

I notice in the "Water Supply and Irrigation Papers" of the United States Geological Survey on irrigation in certain sections of California the statement that their irrigation furrows "are generally less than 300 feet long. This method gives particularly good results on comparatively heavy soils, which do not absorb water rapidly. When soils are porous and take water from the furrows freely the furrows are kept shorter than in heavier soils." Our experience leads us to conclude that to avoid leaching our furrows should not be more than 200 to 250 feet long, the furrows wide and flat, and filled as rapidly as possible, shutting off the water as soon as it will run the length of the furrow—three or four minutes. Toward the close of last season we were crowding the whole flow from the pump—600 gallons per minute—into two or three furrows and rushing it through as quickly as possible. Short furrows, with frequent applications of less than one surface inch of water, must be the rule with us.

The increase of yields due to irrigation this year will probably run from 50 to 75 per cent. A number of fine large photographs were taken for the

government, illustrating the appliances and methods used in irrigating.

Professor King has recently been appointed Chief of the new Bureau of Climatology of the Depatment of Agriculture. Professor Belz, one of his assistants here, is to go with him to Washington. Prof. A. R. Whitson will conduct the experiments next season.

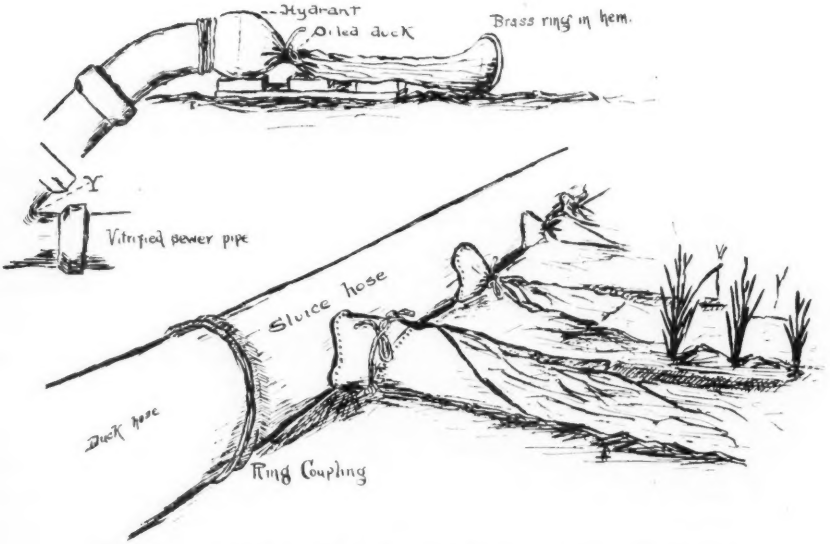
We had three acres of late potatoes which we were anxious to dig as soon as they were ripe enough. We tested them by digging eighteen hills in an irrigated row and an equal weight from an adjoining unirrigated row, which required forty-two hills. I have reason to believe, however, that the average difference in the field was not as large as this. I think the average was about 85 bushels per acre for unirrigated and 135 bushels for irrigated. The yields from the unirrigated strips were above the average annual yield here. This is the first year of these experiments, and considering the fact that all our crops were planted late on account of unavoidable delays in the spring, the results secured this season should not count for as much as average results of several seasons.

One of the most interesting instruments in use here is the evaporimeter. A circular galvanized iron tank four feet in diameter and three feet deep is sunk nearly to its top in the ground. From this tank a tube extends a few feet to one side and rises from an elbow to a small platform, on which is a metal box containing clock-work, which slowly revolves a vertical roller, on which is fastened a sheet of paper, especially ruled and graduated for the purpose. A lever with a peculiar pen fastened across one end, and on the other end a small wire, on the lower end of which is a float hanging in the tube, is carefully balanced so that the pen swings against the side of the roller. Water is filled into the tank until it is nearly full, raising the float in the tube enough to bring the pen to a certain line on the paper. The box is then locked and left for twenty-four hours, when the pen is again adjusted to the same line by adding as much water as has been evaporated, or taking out if rainfall has exceeded evaporation. An irregular line on the paper indicates the amount and rate of evaporation and rainfall during the twenty-four hours. Our irrigations are regulated somewhat by the rainfall thus recorded. It does not matter so much what the evaporation from open water may be, if the soil is thoroughly cultivated evaporation from it may be greatly retarded.

Some simple form of rain gage might be useful to farmers by helping to determine when irrigation is desirable. A simple way of determining when soil needs water is to press some of it in the hand. If it packs in the hand so as to retain the impress of the fingers, it is supposed to be sufficiently moist for plant growth; if not, irrigate. This will do, perhaps, in most cases, but there is so much difference in soils that it will hardly do for a universal rule. There must be sufficient water in the soil so that it will pass by capillarity along the surface of the soil-grains toward the little rootlets which are sucking it in. In clay soils the particles are so very small that there is much more grain surface for water to adhere to, so that the water-holding capacity of such soils is much greater than sandy soils, in which the soil-grains are large and comparatively few in number.

But for the same reason plants can use the water to a lower percentage in sandy soil than in clay soil, since in a sandy soil it is spread over a much smaller grain surface, and the water film on each grain will be thick enough to move by capillarity, while if divided among all the minute particles of clay soil it would be too thin to move. The percentage of water necessary for plant growth in clay may be three or four times as great as in light, sandy soil. Both soils would probably appear to be of about the same dryness, the real difference being discoverable by analysis only. Every man should study the peculiarities and needs of his own soil and not follow general rules too closely.

I have just made two new sluice-hose sections, each 80 feet long, with ports for every furrow, with an apron end to lay into the furrow, which will be more convenient. We have 2,400



DRAWING SHOWING SEWER-PIPE WATER MAIN AND NEW SLUICE HOSE.

feet of 10-inch sewer pipe coming from the factory, which we will lay through the field, with hydrants conveniently located, to which hose will be attached, running across the field on each side of the pipe line, for distributing water to the furrows. In the accompanying drawing the upper figure shows the sewer-pipe main laid low enough to avoid the plow, with hydrant made by bringing water to the surface through a Y and a one-eighth bend, with a short piece of oiled hose attached (the hose is oiled in boiled linseed oil). The lower figure shows the new sluice hose, the ports regulated and closed by drawing heavy hardware cord through brass rings sewed fast and tied with one slip loop, which will hold when wet. Rings of large brass wire are sewed into the ends of the hose and couplings made by slipping one, laid horizontally, through the other and straightening up inside. The sluice hose (which is an original device) seems to be meeting with favor wherever tried.

THE WORK IN DENDRO-CHEMISTRY.

By William H. Krug,

Bureau of Chemistry, U. S. Department of Agriculture.

CHEMISTRY is essentially a general science, in that it has for its object the study of the substances which constitute the universe, the transformations of these substances, and the laws which govern such changes. It is evident, therefore, that there are but few special sciences of which chemistry is not an important and generally necessary part. This is more fully appreciated when we know the extensive specialization which has taken place within the science itself, and most of which is of comparatively recent origin. The field is *per se* so large, and the investigations of the last fifty years have

increased the wealth of chemical knowledge to such a degree, that it is now quite impossible for a student of the science to cover it *in toto*. The chemists of today are forced to choose a special field of investigation, and the effect of this rapid growth of the science has naturally also been felt in the Bureau of Chemistry in the U. S. Department of Agriculture, and last year led to a division of the work, whereby each branch of chemical investigation was enabled to define closely its field, and to concentrate all thought and efforts on the associated problems.

The need of a laboratory which would devote all of its time to the study of the chemistry of forest products, both in its theoretical and practical applications, had been felt for some time, and it was eventually decided to establish such a laboratory. The plans for the organization of the laboratory were prepared by Dr. Wiley, and were approved by the Secretary of Agriculture and the Chief of the Bureau of Forestry. The writer was selected by Dr. Wiley as chief of this laboratory. I believe I can truthfully claim it to be the first of its kind in the United States, if not in the world. A number of laboratories devoted to the chemistry of tanning materials and other materials used in the manufacture of leather are in existence in England and on the Continent, but this line of work forms but a small part of our field. Although the laboratory has now been in existence only ten months, the number of problems which we are working on, or which we intend to take up during the coming year has grown far beyond our expectations. The scope of the work can probably be best illustrated by a brief review of the investigations so far planned.

The first work taken up by the laboratory was a study of the chemical composition of the wood and bark of the *Quercus primus*, *Quercus alba*, *Quercus rubra*, and *Quercus velutina*, our object being the determination of the relationship existing between the chief constituents and the variations occurring in different sections of the trees. This investigation has been extended to the Western Hemlock, and other trees will be taken up in turn until we have an exhaustive series of analyses covering the most important American species. Naturally an investigation of this kind is mainly theoretical, but it must not be forgotten that it has also a practical value, especially with trees which are important sources of tanning materials.

In response to a general demand, we have formulated plans for a study of the availability of certain hitherto unused woods as a source of wood pulp. Spruce and Poplar have so far been chiefly used for this purpose, but the supply of these woods is rapidly being exhausted, and other woods will in time have to be used. It is proposed to make this work most comprehensive, both from a chemical and microscopical standpoint. The various woods will be subjected to the processes of disintegration now used, the conditions obtaining in practice being imitated as closely as possible, when the resultant pulp will be studied with reference to the yield, nature, and condition of fiber and utilized as a basis for papers. The results thus obtained will then indicate the variations necessary in the processes so as to make them conform to the properties peculiar to each wood. In connection with this work we have planned a study of the composition and physical characteristics of the various papers containing either mechanical or chemical wood pulp which are found on the American market, our ultimate object being the establishment of a paper-testing laboratory similar to that now operated by the German Government in Berlin. The necessity of such a laboratory is apparent when we consider that practically all official publications are now printed on such paper, and that the life of wood-pulp papers is in general very brief. The importance of certain standards is self-evident, and we hope to establish and enforce these for the American papers, at least in so far as they are furnished to the government.

An investigation recently suggested and which will receive our attention as soon as the material is at hand is a study of the chemical composition and physical properties of American-tanned sole leathers, for the purpose of determining

the influence of the method of tanning on the character and wearing qualities of the leathers.

In connection with the methods of kiln-drying lumber which are now extensively practiced, the laboratory has been requested to make a study of the effect of dry and moist heat on the physical properties of various woods. The value of these data will be in their practical application in connection with the use of such lumber in buildings. This work has been held in abeyance until appropriate testing machines can be obtained, and we then propose to coöperate with the Road Material Laboratory of the Bureau of Chemistry, not only in this work, but also in the testing of wood paving blocks and the application and effect of wood preservatives. A large variety of the latter are to-day offered, and a comparative study of their effectiveness should prove of considerable value.

Another line of work, which will hardly be received with much pleasure by certain interests, wherein it resembles the work on food adulteration so long carried on by the Bureau of Chemistry, but which will be beneficial in other directions, is an examination of American turpentine as found in the market. It is claimed that adulteration, especially with benzine and rosin oil, is most extensively practiced, the result being a pecuniary fraud by which both the buyer and ultimate user suffer, as paints prepared with such turpentine have less covering power and permanency. In a bulletin on oil of turpentine, recently published by the Inland Revenue Department, Ottawa, Canada, it was shown that 16 per cent of the turpentine sold in the province was adulterated in the manner just mentioned.

In connection with the turpentine industry, we are now engaged in a study of a series of products obtained by a new method of distilling waste pine. I will not enter into the details of the process, as they will shortly appear in a report which we are now preparing for publication in FORESTRY AND IRRIGATION. I may say, however, that this process appears to be the first which successfully and profitably utilizes the larger quantities of dead pine found in the southern turpentine belt.

Probably the most interesting work conducted by this laboratory is a study of the chemical composition, constituents, and possible uses of a series of tree secretions which have been submitted by the Philippine Bureau of Forestry. With the exception of a few of the materials, we have so far not been able to find a reference in the literature, and in some cases the work has proved doubly interesting, as we found investigations recorded which have been made with material of doubtful origin. This naturally introduces an element of uncertainty with reference to the applicability of the final results, and it is fortunate that the materials sent us for examination have in general been carefully identified. Arrangements have also been made whereby the laboratory will be supplied with samples of the various parts, such as the bark, wood, leaves, and secretions, if found, of all new trees reported by the exploring parties sent out by the Bureau of Forestry in Manila, and these materials will form the basis for a series of investigations having both a purely scientific and a commercial value.

In connection with these various problems we have also planned a series of microscopical studies of woods and barks, and work of this kind is now progressing with reference to the oaks previously mentioned. The object of these investigations is not merely histological, as we are aware that considerable work of this kind has been done. Our chief aim is to study the histochemistry of the cellular structure, and a number of interesting observations have already been recorded. A large amount of microscopical work will also be required in connection with the investigations on wood pulp and papers.

During the coming spring the laboratory will also conduct an investigation on chemical methods of killing useless timber.

Finally I may mention the study of analytical methods, especially with reference to tanning materials, which is conducted each year in connection with

the Association of Official Agricultural Chemists. It is not so very long ago that the American tanner or extract manufacturer considered a chemical analysis to possess no value whatever, and preferred to buy or sell on the basis of the density of the material. This state of affairs was chiefly due to erroneous methods of analysis and the lack of uniformity even when the same method was followed. Through consistent effort and study on the part of a number of chemists interested in the subject, this has been changed, and at least 75 per cent of the tanning extracts and materials found on the American market to-day are sold on the basis of an analysis by the official method. At the last meeting of the association it was agreed generally that this method is now practically perfect, and it was therefore decided to take up the study of other analytical methods applicable in a tannery, the object being to eliminate the sources of error now existing. The ultimate aim of all this work is the adoption of an international method for the analysis of tanning materials which will be a service to the American importers, as the European chemists are now using a method which gives to an extract or tanning material a valuation from 1 to 2 per cent higher than the official method.

THE HYDROGRAPHY OF COLORADO.

By A. L. Fellows,

U. S. Geological Survey.

THE relations existing between hydrography and forestry are intimately bound together. Hydrography being, generally speaking, the study of water in all its characteristics and uses, it logically follows that the relationship between the two sciences is so close that they are almost inseparable.

It is within the province of the United States Geological Survey to examine into all the inorganic resources of the country, and one of the greatest of such resources is, as all will admit, our water supply. So great is the importance of this branch of the investigations that labor along these lines has been delegated to a separate division, namely, the Division of Hydrography of the U. S. Geological Survey, of which Mr. F. H. Newell is at the head. Its work is the study of all problems connected with the existing supply, whether derived directly from rainfall or from the run-off of drainage basins, whether these problems bear upon amounts available for use or upon the use itself.

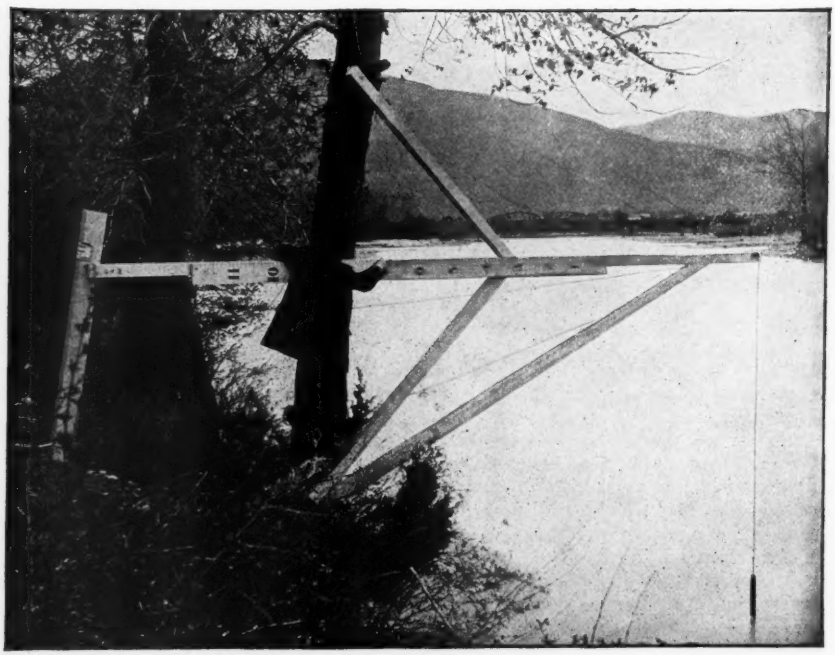
In the pursuit of information along these lines a number of gaging stations have been established throughout the country generally, but more particularly where the call for such investigations has been the greatest. In Colorado, for example, petitions have been sent in from nearly every part of the state, asking that investigations be carried on with a view to ascertaining the amount of water available for irrigation, either by diversion directly from streams or by means of storage. In accordance with these requests, about thirty-five gaging stations have been established and are being operated at the present time. Petitions have been sent in from Maine to California, more from some states perhaps than from others, but enough from all to indicate the great demand for definite information concerning our available water supply and the uses to which it may be put. By some states appropriations have been made for the purpose of coöperating in the work with the Division of Hydrography, the basis of agreement being usually that the Survey will, if it is in its power, devote the same amount of money that the state itself devotes to the investigation. In many cases the amount appropriated by the state has been exceeded; in some cases the states have appropriated nothing, although they have requested that

the work be done, which is accordingly being carried on as far as possible. In Colorado the State Engineering Department has coöperated to the extent of their ability, making measurements whenever possible and furnishing other invaluable assistance.

The principal uses to which water may be put are, in general, domestic supply, irrigation, mining, milling, and power purposes generally, and the amount of use will, of course, depend upon the amount of water available and the amount of power that may be generated, this amount being dependent both upon the flow of the stream and the available head.

While, of course, there is not at present so great a demand in the East for information concerning water for irrigation, there is an equally great, if not greater, demand for information concerning the amount available for all the other purposes named. In Colorado we make use of water for all these purposes. Upon the same stream the water may perhaps be first used in the development of power and in concentrating the ores in our stamp mills in the mountainous tracts near our mines. Again, a little farther down, it is taken up and used for placer mining. Still again, it may be taken out near the mouth of the canyon, and by utilizing the head obtained through flumes, pipe lines, or otherwise, power is generated; and, again, at the mouth of the canyon the water is taken from the natural bed of the stream and is diverted by means of flumes or ditches to the contiguous tracts of tillable land, and through the use of water thus obtained the agricultural products of Colorado have become of greater importance than even the mining products. Again, the water which has percolated into the soil and thus forms an underflow may be once more brought to the surface and again used for irrigation by means of the power generated at the mouth of the canyon.

In addition to all these uses some provision must have been made along the course of the stream for water for the domestic supply of the settlers and the



A RIVER GAGING STATION.

cities in the drainage basin; so that practically upon many of the streams of the state, as will eventually be the case upon all, every drop of water is used over and over again. I have said that the amount of use that may be made of the water supply is dependent upon the amount of water available; this will, of course, depend upon the precipitation and the area drained by the stream and its tributaries and upon the general nature of the country; a sandy and level drainage area giving far less run-off than an equal area covered with rocks; and similarly, a tract covered with forest permitting a less violent discharge, although a more continuous and protracted flow than a similar tract denuded of all vegetation.

In the investigation of our water supply the stations established may first be classed generally in two divisions: those which are of a more or less permanent nature—that is, are expected to be continued for a considerable term of years, and those which are of a temporary character, or which are expected to be kept up for from one to four or five years at the most. Those of the first class are generally located upon the most important streams and at the most practicable points upon these streams for deriving correct information concerning the flow. Those of a temporary character are established upon the smaller streams, either at the most important points or at points where especial information is desired, and at intermediate points upon the main streams. Of a permanent character may be named those stations which are situated at the mouths of the canyons of the large streams and those stations situated near the boundaries of the state; for example, upon the Rio Grande, in Colorado, both stations maintained at present are of a permanent nature, one of them being practically where the water debouches from the mountains, and the second being near the point where the river crosses the line between Colorado and New Mexico. Of a temporary nature, so far as the Geological Survey is concerned, at least, are such stations as those upon the tributaries of the South Platte and of the Arkansas and upon many of the western streams of the state, where only general information is desired as to the amount of water available for different purposes.

All stations established, whether of a permanent or of a temporary nature, have some especial reason for their establishment, however, and these reasons may vary as the uses to which the water is put vary. In one place the investigation may be simply for the purpose of diverting the amount of water available for irrigation directly from the stream; in another case it is desired that the amount which goes to waste in a given stream may be known in order that if possible this loss may be prevented and thus reservoirs be made available. Or a station may be established in order that the discharge of a stream may be known with reference to the power that might be developed from this stream; or, again, a station is established for the purpose of ascertaining the amount of water available as a city water supply upon some of the smaller tributaries of the main streams high up in the mountains, perhaps.

One of the principal uses to which water is put in Colorado is irrigation, and consequently some of the most important information to be derived is for this purpose. Colorado is divided into six irrigation divisions, and each of these is in its turn divided into a number of irrigation districts, the divisions being governed in general by a superintendent who is under the direction of the state engineer, and each district being governed directly by a water commissioner, who reports to the superintendent. Many of the stations established have been for the assistance of the water commissioners in properly dividing the water of the streams among the various consumers, this being the especial province of the state engineer, who coöperates most fully and heartily with the work of the Division of Hydrography in this respect.

I shall not go into the details of the different irrigation districts at this time, but mention in brief the different irrigation divisions into which the state is subdivided, with particular reference to the different drainage basins. These

are irrigation division No. 1, or the Platte River Division; No. 2, or the Arkansas Division; No. 3, or the Rio Grande Division; No. 4, or the San Juan Division; No. 5, or the Grand River Division, and No. 6, or the Green River Division. Of these the difficulties in distribution of the water are greatest in divisions 1 and 2, and hence the most stations have been established by request in these divisions.

In the South Platte irrigation division the station at Platte Canyon is maintained with particular reference to the power that might be developed and the water available for irrigation purposes. The station at Denver is for the assistance of the water commissioner in the distribution of the water at that point, as is also the principal object in the stations upon the tributaries of the South Platte at Forks Creek, Boulder, Lyons, Arkins, and Fort Collins and the others, although in each of these cases the question of available power also enters. The station at Kersey was established for the purpose of ascertaining the amount of water that might be stored in reservoir sites known to exist north of the river, as was also the station at Orchard. The station at Julesburg was established with particular reference to possible interstate controversy. In division No. 2 a similar state of affairs exists. The permanent stations at Canyon City and Pueblo are maintained for the purpose of determining the amount available both for irrigation and for power purposes. That at Barton is maintained because of its importance as an interstate station, while the intermediate stations are kept up principally on account of the assistance afforded to the water commissioners in the distribution of the waters. The same state of affairs exists in the other divisions of the state. Most of the temporary stations are intended to be kept up, as has been stated, for a year or two only, work then being transferred to some other stream or to some other point on the same stream.

Another important branch of the investigations is embraced in the low-water measurements made each year upon the various streams in the state. It is our intention to cover each year certain streams not as yet measured, beginning with low-water measurements, data as to the forestation and the possibilities for reservoiring water, and the development of power.

Still another branch, which is taken up more particularly by the state engineer's office and by Professor Carpenter, of the State Agricultural College, is the measurement of the return water, or seepage. This is carried on quite extensively in the state, and a vast fund of valuable information has been thus derived.

The *modus operandi* at each of the stations is practically the same, although it may differ in detail. Usually there is a gage observer, who reports the daily gage heights of the river, the station being visited by the hydrographer at the high-water stage, the low-water stage, and at various intermediate points, and from his measurements a rating table is calculated, which gives approximately the discharge for any given height upon the gage rod. In this way the discharge for each day of the year or for an entire week, month, or year may be readily calculated.

The most important work under way in the State at this time is the survey of the possibility of diverting water from the Gunnison River into the Uncompahgre Valley. A topographical survey and a geological examination are now being made with reference to this point. This is a possibility that has been talked of for years and is considered of first importance.

The development of power is as yet in its infancy in Colorado, although upon some streams—as, for example, the San Miguel River—practically every drop obtainable at the low stages is now used for this purpose, in some cases the water being taken and used over and over again. The same condition will undoubtedly obtain upon the other mountain streams of the state in the near future, and I venture to prophesy that the future of electrical engineering in Colorado is very bright.

The forest reserves of Colorado are upon the headwaters of some of the most important streams, and their tend-

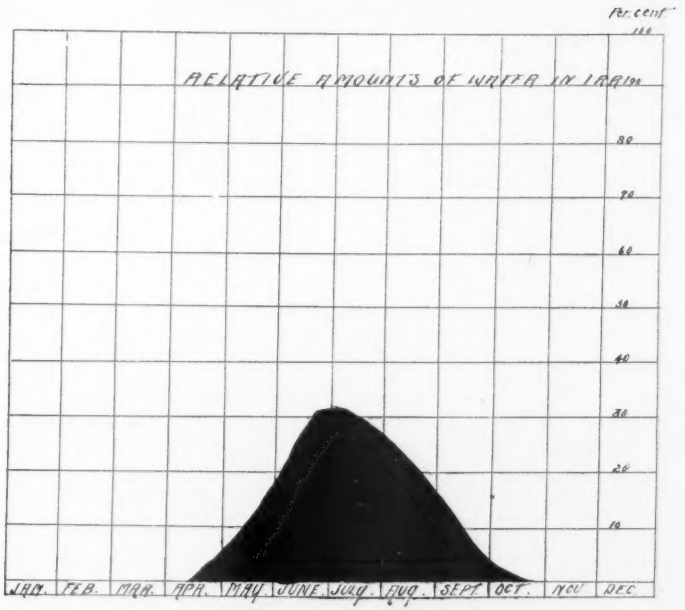


DIAGRAM SHOWING AMOUNT OF WATER REQUIRED FOR THE IRRIGATION OF THE AVERAGE FARM IN COLORADO AT DIFFERENT SEASONS OF THE YEAR.

ency is to retard the melting of snows in the spring and to hold back the moisture in the ground. For this reason the run-off is more gradual rather than so violent, as is the case where the hillsides have been entirely denuded of their timber, either by forest fires or by clearing. The absolute tendency to thus retard the flow of the waters in the streams is so self-evident and has been so thoroughly demonstrated that I do not care to go into this matter, but introduce the subject for the purpose of showing the necessity for long-continued measurements upon our streams, which shall prove beyond question the value of these forest reserves to the irrigation interests. The forests of Colorado should be entirely under the supervision of the Bureau of Forestry. I hope that eventually such will be the case, and that then the sphere of the Bureau will be limited, not to two or three forest reserves, but to the preservation and proper use of the forests of the entire state.

I cannot refrain from saying a few words to call attention more forcibly to the importance of this relation to the irrigation interests. In the accompanying diagram I have endeavored to show approximately the amount of water required for the irrigation of the average farm in Colorado at different seasons of the year. This diagram is based upon observations and experiments made at a number of experiment stations, principally by the Department of Agriculture, and, while any generalization of this kind must be merely approximate, it is safe to assume that it is nearly correct. The diagram made up from the data obtainable shows that the principal use of water is in June and July, probably the maximum in Colorado being about the 1st of July, thus occurring about a month or so later than the maximum of the discharge in our streams. It is not my intention to go deeply into the statistics showing this fact at this time, but will refer you to the reports of the irrigation division of the Department of Agriculture, under Mr. Elwood Mead, and to the reports of

Professor L. G. Carpenter, of Fort Collins, Colorado, for definite proof. I simply wish to call your attention to the fact that anything that tends to retard the flow of our streams, making the maximum flow later than it would otherwise be, is in the nature of reservoiring the water supply, and that for this reason the preservation of our forests with this object in view is of the utmost importance to all irrigating districts.

I am satisfied that if our observations had been kept up long enough upon our streams the records would demonstrate the fact that where the forests have been removed the run-off has been more violent early in the season and the discharge almost nothing in the later part, whereas originally there was a much more steady flow for the summer months. I have many figures that would seem to indicate this fact, but it is impossible to generalize from the measurements of any individual year or for any short period of years. In the records which I have a generalization seems to indicate at least that the minimum flow of streams where the forests have been burned off is very much less than the minimum flow of years before the damage had been done, and that the minimum stage comes much earlier in the year. This fact is much more clearly evident than the fact that there is any material change in the maximum discharge, as the different years vary so widely in the amount of precipitation upon which the run-off depends, although here, too, the indications are that the maximum discharge comes earlier in the year than it did previously. A comparison of the statistics at hand illustrates two facts: First, that forestation, by tending to equalize the flow in our streams and retarding the maximum stage, will be of the utmost assistance in furnishing the water at the time when it is most needed for irrigation, and, further, by increasing the minimum amount it naturally permits of increasing those crops which require the most water late in the season, these crops being in many instances our most valuable agricultural products. The second fact suggested is that even under the most favorable conditions there will still be a vast surplus of water which cannot be used to advantage unless the floods are stored in artificial reservoirs. So that in our slogan, "Save the forests and store the floods," we have two animating impulses which are not merely akin, but which are so closely akin that they will prove to be like the twin brothers, Castor and Pollux, of old, who shall conquer and reclaim arid America.

LUMBERING IN NEW HAMPSHIRE.

By Albert W. Cooper and T. S. Woolsey, Jr.

BROADLY speaking, there are two methods of lumbering which for generations have been practiced in New England. The one is clear cutting. The other, through limitation of size of stumpage, allows a fresh crop every dozen years or so. This, in many cases, approaches the ideal of the scientific forester. It is customary in the great lumber state of Maine. Now, however one may regard these two methods, the practical processes in both, of getting the tree from the stump to the mill, are alike interesting.

The operations of J. E. Henry & Sons, North Woodstock, N. H., are an instance of clear cutting. They have applied this method of lumbering partly owing to their nearness to market, so that nearly everything can be utilized, and partly because their land for the most part contains spruce timber. A pulp mill run in connection with their sawmill enables them to use the spruce unfit for timber.

Their tract is a large one, situated in the Franconia Notch, and running up over the slopes of the Franconia Moun-

tains. Its southern end is near the village of North Woodstock, about a mile from which are situated the firm's saw and pulp mills. From this point their land runs in a northerly direction, well up to Mt. Washington and the Presidential Range, comprising in all about 130,000 acres.

As the branch of the Pemigewasset River was not drivable, a broad-gage railroad was built to haul out the timber. The road follows the stream until three miles from the mill, where it branches out so as to cover the country known as the "East Wilderness." A triangular valley is surrounded by mountains, and it is on these slopes that the present lumbering is going on.

The railroad is joined by the main hauling roads. These roads are remarkable for their average excellence. Mr. Henry believes that it is wise economy to put more money into roads and save in horseflesh. These roads are from 8 to 10 feet in width, and often show a cut and fill of over 6 feet. The important roads are built during the summer. These are more expensive than winter roads, but a road built in winter is useless as soon as the snow melts. They cost from $1.50 to $2.18 a rod. The summer work makes swamping cost higher and requires more blasting and leveling. The upper portion of the main hauling road, however, is usually completed in winter. The cost runs from $0.73 to $1.50 per rod. Swamping is less thorough, and the stumps and rocks can be skidded over without the need of removal. The spruce tops are piled against the side logs and side posts, and thus little or no cut and filling is necessary. The duty of marking where the road shall be run is left to the foreman of the swamping gang. At present the system of marking is to blaze the lower side posts and run the road above the blazed line. Skidding, placing of stringers and slew skids (which are necessary to slew the logs on short steep turns) is also left to the foreman. To prevent drifting during the winter months, groups of spruce are left to windward of the exposed stretches of road. These, it is believed, save much by the protection they afford the hauling surface.

The care of the roads during the hauling season is an important consideration. As a rule, one road-tender is required for 50 rods of road. Practically his only duty is to keep his stretch of road grav-

LUMBER AND LUMBERED LAND, NORTH WOODSTOCK, N. H.

eled. The use of girdle and tail chains is not allowed, for it is believed they tear up the roads and make dangerous ruts. The system of graveling makes it harder hauling back the empty bunks, but the down journey is made with greater safety.

Since the summer of 1901 J. E. Henry & Bro. have adopted a narrow-gage switch-back system, and at every angle of zigzag an extra length allows the cars to pass. The road is portable and see-saws up the slope. The ties are laid about 4 feet apart, 1,200 to the mile. Thirty-pound steel rails are used, and weigh 50 tons to the mile, at a cost of $30 a ton. The empty cars are hauled up by three horses, and are run back in pairs by gravity, with three men to brake. According to the first year's figures, this system is about 10 per cent cheaper than hauling roads for summer work. There was some difficulty in deciding between a broad and narrow gage road. A broad gage would take a larger load and could have been run to the mill without reloading. On the other hand, the extra cost of grading and swamping for a broad gage was calculated to more than balance what was gained in not having to reload. The only change in next summer's operations will be the trial of a Baldwin logging engine in place of horse-power for hauling up the empties.

In addition to the main logging roads up the mountains, there are temporary and twitch roads. These are built entirely in winter. The temporary roads branch off from the main roads at short intervals, and run parallel to each other along the mountain sides. They are built from day to day as the cutting advances, and are comparatively inexpensive, since snow is an important factor in their make-up. Each road serves for hauling off the logs cut on the strip of hillside between it and the next road above. In this way the logs are rolled down the slope to the road.

SKIDWAY IN PROCESS OF BUILDING.

In some parts of the mountains, where the pitch is too steep to permit of direct hauling, the difficulty is solved by putting in short twitch roads. These run back from the nearest temporary road at intervals of 100 yards or so, joining it at an acute angle. In this angle there is a skidway, to which the logs are twitched by horses, one at a time, and from the skidway are loaded onto the sleds. This system of twitch roads avoids expensive and difficult grading.

The trees are cut by notching and sawing and are felled parallel to the road, thus rolling down the slope. The cutting begins at the foot of the slope and works upward; the tops and limbs are left to form a sort of rude skidway, and thus facilitate the downward progress of the trees. Sometimes a log, starting at the top of a slope, gains such headway that bumpers are necessary on the farther side of the road to check its progress.

After the trees are felled and lopped they are loaded on a sled drawn by a pair of horses, and bound on by bunk chains, the hind ends dragging in the road. A load consists of from four or five to a dozen or more logs, according to their size and the condition of the particular road. This hauling is one of the most dangerous parts of the work, and only skillful drivers are employed. In spite of this, horses are often injured or killed on bends or steep slopes where the road is slippery. In such a case the driver is or is not held responsible, as the circumstances of the case and the driver's reputation for carefulness seem to warrant.

This firm has but one set of roads; that is, there are no return roads. The teams haul two loads per day apiece, one in the morning and another in the afternoon.

Along the line of the railroad, at the end of each main hauling line, are the skidways. These have as many landings as there are cars to be loaded—say 4 to 6—and each landing has an estimated storage capacity of 10,000 feet, b. m. In case the main road is tied up, the logs can be stored along the hauling road, or where the cutting is going on. Where possible the main skid logs are Birch or Hard Maple; otherwise Spruce. The logs are always peeled to prevent injury from borers, and to make rolling the timber easier for the landing crew. Each landing has an upper and lower platform, with bunting posts at the lower edge, to prevent the logs from sliding onto the cars. There is a drop of 3 feet from the lower platform to the top of the car. A higher drop is apt to split a long log. When the teams come in the load is scaled and the small pulp logs are dropped at the first two landings, the better logs at landings 3, 4, and 5. This is a simple method of sorting, and saves time at the mill. The landing crew is responsible for unloading the teams, and also for loading the cars. Their work is considered the hardest of any crew.

J. E. Henry & Son's lumber camps are very much after the fashion of logging camps in general, save in some particulars which seem worthy of mention. First of all, the camp buildings are made of boards instead of logs. These are found to be cheaper, as the logs are more valuable for either pulp or lumber. They are enabled to do this by the fact that they have their own sawmill near at hand and operate a railroad of their own. Another interesting feature of their system is that of transporting the camp buildings from place to place by means of the railroad. Buildings of this sort are either long and narrow or built so that they can be readily taken apart. They are usually 14 feet in width, and from 30 to 50 feet long. Of course, camps of this description are usually confined to the railroad at the foot of the mountains, while those farther up are built of logs. These latter are burnt down when they are abandoned, to discourage possible campers who might carelessly start fires.

The scarcity of labor is an important difficulty in the way of successful lumbering at North Woodstock. The men are the gainers both in wages and in treatment. The cook receives $50 a month and board, the teamsters from $28 to $32.50, paying $3 per week for board; the skidders, landing crew, choppers, sled-tenders, and road-tenders from $26 to $33, paying for board. A rule of the wage scale is that a man when sick must pay board and not receive pay. Few are sick in the camps, but the men feel that it is an unfair system. Many men will work for them in preference to other lumbermen on account of the good food furnished. Fresh beef is served three times a week, and the cooking is unusually good. In winter the men are allowed to return to camp for dinner. At other camps we visited a cold lunch was carried to them. A

fee of fifty cents a month guarantees the men hospital treatment when laid up. As a business proposition this firm has realized that the good health of the men is essential to success. That they act upon this is shown by the fact that spring water is piped to three of the summer camps in preference to using the brook water.

Every detail points to the care and thoroughness of their lumbering. There is no waste timber left in the woods. All side logs, stringers, and slew skids are hauled out when the roads are abandoned. The skidway logs are peeled for protection against borers, so that they can be converted later on. The movable camps and stables, the government and care of the men, the good road and switch-back systems are evidences of economical and careful lumbering. While their lumbering shows great skill and business ability, yet there is no provision for the future. They are not letting the cut-over land go for taxes, and yet the future growth is not considered. By some moderate and simple system of forestry it is believed that the firm could realize heavily and at the same time improve the future value of the land. Some system is absolutely necessary if the land is to be held. If they should wish to sell, they would get a higher price with the land well stocked with young growth. At present the clear-cutting system includes the stunted growth on the mountain tops. If this growth were left, little lumber would be lost, and it would insure reproductiou. The steep slopes and high wind would play an important part in the natural sowing. Under the present system the groups of spruce (left to protect the roads against snow) are cut last. Should these groups prove windfirm, their removal might be delayed a year or so in the chance of their aiding reproduction. In the Adirondacks a strip or patch system is used on this type of spruce slopes. By modifying these systems as above suggested, it is reasonably certain that the financial requirements would not be interfered with, and that the future value of the land would be increased. With the enormous demand for pulp wood, every owner should plan for the future.

LUMBER CAMPS NEAR NORTH WOODSTOCK, N. H.

RELATION OF FORESTS TO THE MANUFACTURING INDUSTRIES OF TENNESSEE.

By R. W. POWELL,

President of the Powell Lumber and Mining Company.

THE figures for the wood-working industries of the state for the year 1900 are not yet available from the Census Bureau, and I have not been able to obtain from any of the chambers of commerce of the four large cities of this state any statistics which would show the rate of increase in manufacturing from forest products, but which it is quite certain is rapidly growing. I will therefore devote most of my paper to a few things which have come under my personal observation or through correspondence with those who have taken some interest in these matters.

The great and almost unequaled natural resources of Tennessee have been testified to by such men as Abram S. Hewitt, Edward Atkinson, Professor N. S. Shaler, and Col. Geo. B. Cowlam, but they have also called attention to the fact that these resources are not yet utilized in such a way as to make this great commonwealth what it should be. In these days of fierce industrial competition, no community which permits waste to go unchecked, or neglects the future of its citizens, can maintain a good relative position. Argument is not needed here in this matter, and it will not be disputed that our forests might be so utlilized as to bring more money to us now and at the same time be better conserved for the future.

Between the years 1830 and 1840 the State of Tennessee actually gave away, in seven counties alone, coal lands fully equal in quality of product to those of the Connellsville region of Pennsylvania, and which, if situated in that region, would now be worth not less than $50,000,000. These lands should have been reserved for the future of the state, and if so reserved would have gone a long way toward making this commonwealth free of taxation for state purposes for all time to come. It will probably be many years before public sentiment will demand that the state exercise its right of eminent domain and resumes its ownership of the coal-fields or of the great forests which are now being so badly administered, but it ought not to be long before action of some kind is taken toward state supervision of forest lands which are at the headwaters of our magnificent rivers. In the meantime let us ask ourselves if there are not now some ways by which private landowners may help themselves and at the same time aid in the general welfare.

During the months of November and December, 1898, I made a thorough personal examination of the Chestnut Oak regions of North Carolina, Georgia, Alabama, and this state with a view to the establishment of a certain business connected with the tanning industry. A reference to careful notes then made, and since then added to, indicates that the tanners of the State of Tennessee and one other in the immediate neighborhood of Chattanooga are now using about 75,000 cords of bark a year, and this is mostly from Chestnut Oak. To furnish this amount of bark, the amount of timber required is probably not less than 150,000,000 feet, b. m. The general practice has been to fell this kind of timber for the sake of the bark alone and leave the trunks of the trees to decay in the woods. This may be partly owing to the fact that the trees have to be felled, if taken for bark, at a time when the sap is rising, and therefore not the best time to make good lumber. I believe that there are ways by which this kind of timber could be cheaply treated, and while in the woods, in such a way as to produce a very much better quality of lumber and make it worth while for the lumbermen to handle it in larger amounts and to their greater satisfaction. It might also be used much more exten-

sively for railroad ties, for which it is even better than White Oak if cut under equally good conditions, as could be shown by some experiments reported on by the Nashville, Chattanooga and St. Louis Railway. When the Tennessee Central Railway was being built I was amazed to find out that the cross-tie buyer for the contractors knew nothing about the value of chestnut-oak cross-ties and would not accept them. According to the U. S. Department of Agriculture (see Yearbook of the Department for 1900, p. 148), Mr. J. Hope Sutor, general manager of the Ohio and Little Kanawha Railroad, after giving the matter careful consideration, estimates the value of a cross-tie fifteen years hence at 75 cents. Mr. Sutor also says "No material has yet been found as a substitute for the wooden tie, and no satisfactory economical method of preserving the life of the wood or prolonging its durability has yet been discovered, and excepting the minor qualities of properly seasoning and piling, the use of the tie-plate, suitable ballast and perfect drainage, and incidentally climatic conditions, no serious consideration of the tie supply has yet been had." If the above supposition is correct, is it not worth while for the large railway corporations of this state to look further into this matter, as the outlook for the future is clearly toward heavier rails and rolling stock, which will make it necessary to use more and better ties, both for economy and safety.

Before leaving the question of the amount of Chestnut Oak needed for the tanning industry, it should be said that Mr. M. V. Richards, the land and industrial agent of the Southern Railway Company, writes that "the indications are that other tanneries will be established along this railway in the near future. At present a large proportion of the timber from which the chestnut-oak bark has been taken is now going to waste, but we are coöperating with timber-land owners in finding markets for this low-grade lumber."

My estimate, as before given, of the amount of Chestnut Oak used for tanning in this state does not include what is used for making extract. This is a large and growing industry, but I am not now able to give any figures regarding it. There is a difference of opinion as to whether the supply of chestnut-oak bark is likely to be seriously reduced below the growing wants of the southern tanners, but, at any rate, it is not best to continue the present waste of such a large proportion of the timber if anything can be done to avoid it.

There are also other matters which may possibly be worthy of attention as affording some revenue for the owners of forest lands, and in such a way as not to injure the future of our forests. In *The Forester* for June, 1900, there was an article on "The Paper Industry and Forests," contributed by Mr. C. W. Lyman, of the International Paper Company. According to the figures given by him for the year 1899, the pulp industry of the United States was consuming daily 6,648 cords of wood, which would approximate an annual consumption of 955,400,000 feet, b. m. This may seem like a large amount, but Mr. Lyman shows in his paper that it is less than one-half of 1 per cent of the total wood used for other purposes. The paper pulp industry does not yet seem to be established in the southern states, as the figures given by Mr. Lyman for 1899 show only 8 small mills south of the Ohio River and the Virginia and West Virginia lines, with a total daily capacity of but 26 cords. Of these 8 mills, only one was then given as located in this state, and it had a daily capacity of only two tons. It is very probable that this industry might be very largely increased in our state and with positive benefit to our forests. In the State of New York, which had 100 mills, consuming over 2,300 cords of wood a day, the material used is largely the tops of Spruce. The removal of these tops from the forest tends to reduce the damage from fires, and is therefore of use from the standpoint of practical forestry.

I do not know anything about the amount of Spruce in this state, but the Hemlock (locally called Spruce Pine) seems to be a softer and finer-grained wood than the Northern Hemlock, and it is possible that it might be used to good advantage in making wood pulp.

Our forests are also full of poplar tops now worse than wasted, and the forests would be better for their removal. Professor Sargent says that Chestnut is occasionally used in pulp-making. If this can be done to advantage, it might be worth while for the pulp manufacturers to look into this matter, as there are certain sections of the state which contain large amounts of overripe and dying Chestnut which ought to be removed, and which could be bought at a very low price.

Another use could also be found for the wormy and wind-shaken Chestnut which is unfit for good lumber. In the brick-making sections of the north and Canada, Chestnut is preferred for fuel, as it burns with a clear flame, and therefore makes a better quality of brick. More good brick are needed in this state, and there are locations where a combination of choice clay, cheap Chestnut, and railroad transportation can be secured.

But more important than any of the matters above noted is the necessity for the owners of forest lands to show more confidence regarding the future, and to either refuse to allow their best timber lands to be skinned of the most valuable White Oak by the stave and spoke manufacturers and the remaining timber to be seriously injured, or else to insist on more careful lumbering by such parties.

In the *Southern Lumberman* for July 15, 1901, Mr. Baird predicts that the local consumption of lumber products in the southern states will probably increase 100 per cent within the next five years. This is certainly a conservative prediction, and to meet the future demands for good timber woods we ought to take better care of our forests. On December 1, 1898, I was at High Point, N. C., and was much impressed by what that new place was doing in the way of manufacturing furniture for the general markets, both of the South and the North. Instead of shipping away their oak lumber they were using it themselves and to their great advantage. The whole place had an air of prosperity and comfort that was most delightful.

In answer to a recent letter of inquiry, Mr. Richards, of the Southern Railway, wrote me:

"The furniture-making industry is making a very rapid development along the line of the Southern Railway. During the last fiscal year 54 new plants were placed in operation and there are a large number now in course of erection. This industry finds in the South many favorable conditions and will be increased to a great extent within the next few years.

"The forest areas of the South are now the principal source of supplies for plants in the North using hard-wood, and quantities of lumber and timber are now exported.

"From High Point, N. C., the shipments of furniture now aggregate some 12 to 25 car-loads daily."

What is being done in High Point, N. C., can be even better done in many places in this state if the right men will take hold of the problem. We need more diversified industries in Tennessee, and to that end should take care of our natural resources and utilize them to the fullest extent and do what we can to bring the furniture plants of the North to us rather then send our raw material to them. The laws of the state are probably liberal enough with regard to manufacturing industries using home products, and I am rather inclined to think that what is needed more than anything else at this time is a little more confidence and foresight on the part of owners of forest lands.

In addition to the above suggestions, many others could be given along somewhat similar lines, but each man for himself, as interested, can ask what he can do to make his own future better, while at the same time not forgetting that he is but part of a great commonwealth. We have the advantage of the economic history of other communities, both here and abroad, and the sooner we put ourselves in complete touch with our progressive neighbors the sooner we will get back into our former relative position with our sister commonwealths.

FORESTRY AND IRRIGATION IN CONGRESS.

THE MONTH OF APRIL, 1902.

April 4.

Mr. Burleson introduced a bill (H. R. 13361) to provide for the equitable distribution of the waters of the Rio Grande River between the United States of America and the United States of Mexico. To the Committee on Foreign Affairs.

April 9.

In the Senate, Mr. Clark, of Montana, presented a petition of the Montana State Agricultural Association, praying for the enactment of legislation providing for the irrigation of arid lands of the West; which was ordered to lie on the table.

April 11.

Mr. Burton submitted the following concurrent resolution; which was considered by unanimous consent, and agreed to: Resolved by the Senate (the House of Representatives concurring), That the President be requested to return to the Senate the bill (S. 4363) granting the Central Arizona Railway Company a right of way for railroad purposes through the San Francisco Mountains Forest Reserve.

Mr. Moody, of North Carolina, from the Committee on Agriculture, to which was referred the bill of the House (H. R. 3128), reported as a substitute therefor the bill of the House (H. R. 13523) for the purchase of a national forest reserve in the Southern Appalachian Mountains, to be known as "The National Appalachian Forest Reserve," accompanied by a report (No. 1547).

April 14.

Mr. Martin introduced a concurrent resolution (H. C. Res. 49) providing for the publication of 1,000 copies of the "Preliminary Description of the Geology and Water Resources of the Southern Half of the Black Hills." To the Committee on Printing.

The President *pro tempore* laid before the Senate the following message from the President of the United States; which was read, and, on motion of Mr. Burton, was, with the accompanying bill, referred to the Committee on Public Lands:

To the Senate of the United States:

In compliance with a resolution of the Senate of the 12th instant (the House of Representatives concurring), I return herewith Senate bill No. 4363, entitled "An act granting the Central Arizona Railway Company a right of way for railroad purposes through the San Francisco Mountains Forest Reserve." THEODORE ROOSEVELT.

April 15.

The bill (H. R. 8326) to set apart certain lands in the Territory of Arizona as a public park, to be known as the Petrified Forest National Park, was read twice by its title, and referred to the Committee on Public Lands.

April 17.

Mr. Cooper, of Wisconsin, introduced in the House resolutions of the Wisconsin Game Protective Association, in favor of the conversion of all forest reserves in the western states into game preserves.

April 18.

In the House, Mr. Tongue introduced the following joint resolution; which was referred to the Select Committee on the Census and ordered to be printed:

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Director of the Census be, and hereby is, authorized and directed, upon the completion of the volume of agricultural statistics, the year eighteen hundred and ninety-nine, to complete and bring up to date of the year of the crop year of nineteen hundred and two the statistics relating to irrigation, the area of land reclaimed, the cost and value of the works, and such other information as can be obtained bearing upon the present condition of irriga-

tion; which was agreed to by the House Committee.

April 18.

In the Senate, Mr. Nelson presented a petition of the board of directors of the Chamber of Commerce of St. Paul, Minn., praying for the enactment of legislation providing for the reclamation and settlement of the arid public lands of the West.

Mr. Burton, from the Committee on Forest Reservations and Protection of Game, to whom was referred the bill (S. 5228) for the purchase of a national forest reserve in the Southern Appalachian Mountains, to be known as the "National Appalachian Forest Reserve," reported it, with amendments, and submitted a report thereon.

April 19.

Mr. Tongue, of Oregon, asked unanimous consent for the consideration of the bill (H. R. 4393) reserving from the public lands in the State of Oregon, as a public park for the benefit of the people of the United States, a tract of land having an area of 249 square miles, to be known as Crater Lake National Park.

April 22.

The Committee on Public Lands (Senate) reported back the bill (S. 4363) granting the Central Arizona Railway Company a right of way for railroad purposes through the San Francisco Mountains Forest Reserve. This is the Senate bill which passed both Houses, and while it was in the hands of the President was recalled by a concurrent resolution of the two Houses. On the return of the bill to the Senate it was referred to the Committee on Public Lands. That committee, after considering it, decided to report it back in the form in which it reached the committee, and requested that it be returned to the President for his action.

April 30—CENTRAL ARIZONA RAILWAY. VETO MESSAGE.

Mr. Burton, from the Committee on Public Lands (Senate), reported back the message of the President of the United States, returning, with his objections, the bill (S. 4363) granting the Central Arizona Railway Company a right of way for railroad purposes through the San Francisco Mountains Forest Reserve, with the recommendation that the bill do pass, the veto of the President to the contrary notwithstanding.

The President's message was as follows:

To the Senate of the United States:

I return without approval Senate bill No. 4363, entitled "An act granting the Central Arizona Railway Company a right of way for railroad purposes through the San Francisco Mountains Forest Reserve."

The Secretary of the Interior writes me as follows concerning the attached bill:

"I enclose a copy of the report on the bill by the Commissioner of the General Land Office, dated the 5th instant, for your full information.

"He states therein that it is questionable whether or not this company could be required to supply a bond to protect the government from damage by reason of the occupancy of the right of way provided for by this bill, should it become a law.

"He also states that this company could acquire the right of way under existing laws, as other companies have done, by complying with the usual requirements, one of which is the filing of a bond for the purpose mentioned, and that he knows of no reason why this company should be exempted from such requirements."

In addition thereto, I have had the Commissioner of the Land Office before me. He informs me that in its present form it would be impossible to exact the guaranty from the railroad that would insure its making good damages resulting from fire or any carelessness on the part of the railroad company in the forest reserve through which this railroad is to pass. He further informs me that there is at present a law which will permit the railroad, if it chooses to take advantage of it, to go across forest reservations under proper safeguards, and that there is no reason why this

railroad should be singled out to be favored beyond all other railroads by being excepted from the necessity of complying with the departmental regulations with which all other railroads are forced to comply.

THEODORE ROOSEVELT.

Mr. Clark, of Wyoming, submitted an amendment providing that in granting permits for grazing in the Uintah Forest Reserve no preference shall be given to the flocks or herds of one state over those of another, intended to be proposed by him to the sundry civil appropriation bill.

Mr. Allison proposed the following amendment to the sundry civil bill: "For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells and the preparation of reports upon the best methods of utilizing water resources, $200,000." The amendment was agreed to.

Mr. Lacey introduced in the House a bill (H. R. 14108) to grant grazing privileges to homestead settlers and holders of small farms in the arid and semi-arid land regions, and for other purposes.

RECENT PUBLICATIONS.

The Blazed Trail. A novel, by STEWART EDWARD WHITE, author of "The Westerners." Illustrated. McClure, Phillips & Co., New York. Price, $1.50.

Within the last year or two there have been many additions to the literature on the subjects of forests and forestry, but it has remained for Mr. Stewart Edward White to grasp the possibilities of the lumber camp as the setting for a strong novel. There have been books almost without number of a technical or descriptive character on the birds, animals, and trees, but in "The Blazed Trail" Mr. White has used the forest itself, the pioneer lumberman, and the life of the lumber camp to great advantage in producing a story of decided human interest.

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ILLUSTRATION FROM "THE BLAZED TRAIL."

"The Blazed Trail" is a story of the great pine forests of northern Michigan during the early eighties. As a picture of lumbering operations on a large scale it is unusually graphic, and will give the reader a better idea of how a great tract of timber is lumbered than half a dozen books of a technical character. The author shows himself to be in close touch with the wild life of the woods, and the men in his story are truly "men with the bark on."

Mr. White writes well, and he has been a keen observer of the little things, as well as the great, in the life he portrays. "The Blazed Trail" is a strong story, illustrating a very picturesque phase of American life, and altogether the book deserves high praise. It is a book that all persons interested in forests, whether from the economic or æsthetic standpoint, will find of interest and value

Field Book of American Wild Flowers. By F. SCHUYLER MATHEWS. With 350 illustrations by the author, including 24 colored plates and 200 full-page line drawings. Pp. 525. G. P. Putnam's Sons. New York. Price, $1.75 net.

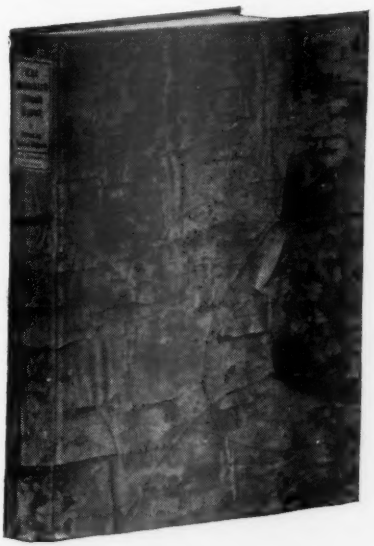
Mr. F. Schuyler Mathews, author of "Familiar Flowers of Field and Garden," "Familiar Trees and Their Leaves," and "Familiar Features of the Roadside," has just published an exceedingly useful book, entitled "Field Book of American Wild Flowers." This book is of a size that it may conveniently be carried in the pocket, and should prove an invaluable guide in the identification of our wild flowers.

The author's arrangement of the text and illustrations is most simple and convenient. On the left-hand page is the description of a flower, while on the page facing is an illustration of the same This order is followed throughout the book. The large number of excellent illustrations are reproduced from water colors and pen-and-ink sketches by the author.

The description of each flower includes its popular and scientific names, a few words on the characteristics of its foliage, size, etc , and its geographical distribution. This book is a valuable addition to the literature on the subject, and should meet with a popular reception in these days of rapidly growing interest in nature study.

The Speckled Brook Trout. Edited and illustrated by Louis Rhead. Published by R. H. Russell, New York.

This is an unusually handsome volume, describing the speckled brook trout, its home and habits, and is by far the most interesting and attractive volume we have yet seen on the subject. The book contains a series of articles on the brook trout contributed by well-known anglers, and the whole arranged by Mr. Louis Rhead, the well-known artist.



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UNIQUE COVER DESIGN OF "THE SPECKLED BROOK TROUT."

The volume opens with a poem on the "Baptism of the Brook Trout," by the well-known editor and author, Charles Hallock. The same writer contributes two interesting chapters on a "General Description of the Trout Family" and "The Old Adirondacks."

There is a chapter on "The Habits of the Trout," by William C. Harris, the well-known author of the "Fishes of North America," and a valuable paper on "Trout Propagation," by the late A. Nelson Cheney. "Winged Enemies of Brook Trout," "Cooking Trout," "Along a Trout Stream," are other topics treated. "The Speckled Brook Trout," like all books published by Mr. Russell, is a fine specimen of the printer's and binder's arts.

The book is beautifully illustrated, there being several colored plates and full-page photogravures and a number of drawings, all contributed by Mr. Rhead. The book is uniquely bound in board covers imitating birch bark.

The "Speckled Brook Trout" should have a place in every sportsman's library; it is, in addition to being a very handsome volume, filled with valuable information.

During the past month there has been a number of interesting articles on forestry and irrigation published in the leading magazines. Following is a list of the most important:

The Irrigation Bill. *Literary Digest*, April 12.

What Forestry Is. Gen. C. C. Andrews. April *Outing*.

Irrigation Legislation. Elwood Mead. *Outlook*, April 12.

The Transformation of the Desert. Robert T. Hill. *World's Work*, April.

The Redemption of Our Dead Lands. Guy Elliot Mitchell. *Munsey's*, April.

American Forestry: A New Career. J. Russell Smith. May *Forum*.

Reclaiming the Arid Southwest. Robert M. Barker. May *Forum*.

A Southern Forest Reserve. *The Southland*, May.

The Art of Forestry. *Country Life in America*, May.

Through the Grand Canyon of the Gunnison. J. D. Whelpley. *Harper's Weekly*, May 3.

A new bulletin by Dr. von Schrenk on "The Decay of Timber and How to Prevent It" has just been published by the Bureau of Plant Industry. This bulletin contains a lot of valuable information collected both in this country and in Europe. This report, which is a basis for much more extensive investigations planned for the future, contains a discussion of the factors which cause the decay of wood, an account of the various methods used in this country and abroad for preserving timber, and also an account of original work conducted to test these various methods. The bulletin contains a number of excellent illustrations.

Another government publication recently issued is Captain Ahern's special report on the work of the Philippine Forestry Bureau, covering the period from its organization, in April, 1900, to July 30, 1901. The report contains 60 pages of text and 33 full-page illustrations, and is published by the Division of Insular Affairs of the War Department.

Practical Courses in Forestry.

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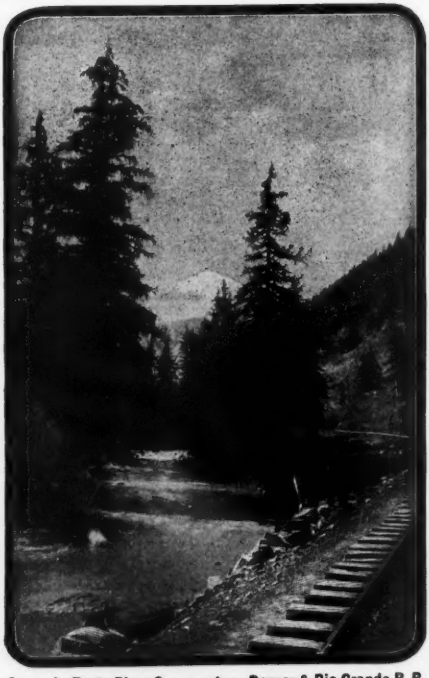

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